ASSOCIATION

OF

Railway Telegraph Superintendents

PROCEEDINGS

OF THE

ANNUAL MEETING HELD AT CHATTANOOGA, TENN.

MAY 17th and 18th, 1905

CONSTITUTION, BY-LAWS, LIST OF MEMBERS, ETC.

MILWAUKEE, WIS.:
J. H. YEWDALE & SONS CO., PRINTERS
1905

ESTABLISHED 1879

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The finest finished, most sensitive and substantial Relay ever made.

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Figure 12.

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There are ***no other*** Instruments "just as good."

Portable, can be moved to any desired position within range of cord. The cord enters base as shown and passes through the hollow stem to sounder.

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No. 20 Park Place, New York

Wheatstone Bridges, Rheostats, Galvanometers, Testing Sets, etc.

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Catalogue free.

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ANNOUNCEMENT

The Association was formed in Chicago, November 20, 1882 Its object is the improvement of the railway telegraph service.

The next annual meeting will be held at Denver, Colorado, June 20th and 21st, 1906.

The undersigned will be glad to answer any inquiries in reference to the Association.

E. E. TORREY, President,
Jackson, Tenn.

E. A. CHENERY, Vice-President,
St. Louis, Mo.

P. W. DREW, Sec'y and Treas.,
Milwaukee, Wis.

THE ASSOCIATION

OF

Railway Telegraph Superintendents

CONSTITUTION AND BY-LAWS

PAST PRESIDENTS

W. K. Morley.....1882
W. K. Morley.....1883
C. Selden 1884
C. W. Hammond.....1885
A. R. Swift.....1886
Geo. L. Lang.....1887
Geo. C. Kinsman.....1888
C. A. Darlton.....1889
G. T. Williams.....1890
C. S. Jones.....1891
L. H. Korty.....1892
U. J. Fry.....1893
O. C. Greene.....1894
G. M. Dugan.....1896
J. W. Lattig.....1897
W. W. Ryder.....1898
L. B. Foley.....1899
W. F. Williams.....1900
C. F. Annett.....1901
J. H. Jacoby.....1902
C. S. Rhoads.....1903
H. C. Hope.....1904

OFFICERS

1905-6

PRESIDENT.

E. E. Torrey.....M. & O. R.....Jackson, Tenn.

VICE-PRESIDENT.

E. A. Chenery.....M. P. Ry. Sys.....St. Louis, Mo.

SECRETARY AND TREASURER.

P. W. Drew.....W. C. Ry.....Milwaukee, Wis.

COMMITTEES

ARRANGEMENTS.

J. J. Burns.....Denver, Colorado.
C. A. Parker.....D. N. W. & P.....Denver, Colorado.
J. Munday.....C. & S.....Denver, Colorado.

TOPICS.

V. T. Kissinger.....B. & M. R.....Lincoln, Neb.
F. H. Van Etten.....C. & E. I.....Danville, Ill.
S. K. Bullard.....M. K. & T.....Sedalia, Mo.

COMPOSITE CIRCUITS.

U. J. Fry.....C. M. & St. P.....Milwaukee, Wis.
G. H. Groce.....Illinois Central .....Chicago, Ill.
R. L. Logan.....K. C. So.....Kansas City, Mo.

USE OF TELEPHONE FOR TRAIN ORDERS.

C. Selden .....B. & O.....Baltimore, Md.
E. P. Griffith.....Erie .....New York, N. Y.
J. S. Stevens.....C. & O.....Richmond, Va.

POLE CONSTRUCTION (To Withstand Sleet and Wind Storms).

Wm. Maver, Jr.....Electrical Engineer....New York, N. Y.
C. H. Bristol.....W. U. Tel. Co.....New York, N. Y.
Frank F. Fowle.....Am. Tel. & Tel. Co....New York, N. Y.
L. B. Foley.....D. L. & W.....New York, N. Y.
G. C. Kinsman.....Wabash .....Decatur, Ill.

TO CONFER WITH AMERICAN RAILWAY ASSOCIATION AS TO STATE LAWS.

E. P. Griffith.....Erie .....New York, N. Y.
L. B. Foley.....D. L. & W.....New York, N. Y.
C. P. Adams.....Southern .....Washington, D. C.

LIST OF ACTIVE MEMBERS

NAME	RAILROAD	ADDRESS
E. E. Torrey	M. & O	Jackson, Tenn.
H. C. Hope	C., St. P. M. & O	St. Paul, Minn.
C. S. Rhoads	C. C. C. & St. L	Indianapolis, Ind.
W. F. Wiliams	S. A. L	Portsmouth, Va.
L. B. Foley	D., L. & W	New York, N. Y.
W. W. Ryder	C. B. & Q	Chicago, Ill.
G. M. Dugan	Illinois Central	Chicago, Ill.
O. C. Greene	Northern Pacific	St. Paul, Minn.
U. J. Fry	C., M. & St. P	Milwaukee, Wis.
L. H. Korty	Union Pacific	Omaha, Neb.
C. Selden	Baltimore & Ohio	Baltimore, M. D.
G. C. Kinsman	Wabash	Decatur, Ill.
Geo. L. Lang	Q. & C	Chattanooga, Tenn.
C. P. Adams	Southern	Washington, D. C.
E. A. Chenery	Missouri Pacific	St. Louis. Mo.
G. H. Groce	Illinois Central	Chicago, Ill.
E. H. Millington	Michigan Central	Detroit, Mich.
H. C. Sprague	St. L. & S. F	Springfield, Mo.
M. Magiff	Central Vermont	St. Albans, Vt.
A. B. Taylor	N. Y. C. & H. R	Weehawken, N. J.
F. G. Sherman	C. R. R. of N. J	Jersey City, N. J.
S. K. Bullard	M., K. & T	Sedalia, Mo.
P. W. Drew	Wisconsin Central	Milwaukee, Wis.
C. B. Phelps	L. & N	Louisville, Ky.
C. H. Gaunt	A., T. & S. F	Topeka, Kan.
W. A. Freeze	C. & A	Bloomington, Ill.
W. W. Ashald	G. T.	Montreal, Can.
Wm. Kline	L. S. & M. S	Toledo, O.
E. A. Klippel	O. R. & N	Portland, Ore.
V. T. Kissinger	B. & M. R	Lincoln, Neb.
N. E. Smith	N. Y. N. H. & H	New Haven, Conn.
C. F. Annett	Panama R. R	Corozal, C. Z.
F. L. Blendinger	L. V. Ry	New York.

NAME	RAILROAD	ADDRESS
B. F. Frobes	O. S. L.	Salt Lake City, Utah
J. S. Stevens	C. & O.	Richmond, Va.
E. P. Griffith	Erie	New York, N. Y.
S. A. D. Forristall	B. & M.	Boston, Mass.
W. F. Taylor	Penna R. R.	Altoona, Pa.
W. J. Holton	Chi. & West. Ind.	Chicago, Ill.
E. J. Little	Great Northern	St. Paul, Minn.
W. C. Walstrum	N. & W.	Roanoke, Va.
F. S. Spafard	C. R. I. & P.	Chicago, Ill.
J. P. Boyle	K. & W.	Centerville, Iowa.
W. P. McFarlane	F., E. & M. V.	Omaha, Neb.
L. S. Wells	L. I. R. R.	Long Island City, N. Y.
G. B. McCoy	Y. & M. V.	Greenville, Miss.
H. A. Tuttle	M., St. P. & S. S.	Minneapolis, Minn.
F. A. C. Ferguson	Miss. Valley	Greenville, Miss.
W. L. Bisbee	H. & T. C.	Houston, Tex.
W. P. Cline	A. C. Line	Wilmington, N. C.
A. E. Roome	So. Pac.	San Francisco, Cal.
R. L. Logan	K. C. So.	Kansas City, Mo.
C. M. Lewis	P. & R.	Reading, Pa.
J. M. Walker	D. & R. G.	Denver, Colo.
C. A. Parker	D. N. W. & P.	Denver, Colo.
F. H. Van Etten	C. & E. I.	Danville, Ill.
J. Munday	C. & S.	Denver, Colo.
F. G. Adams	B. & O.	Baltimore, Md.
W. H. Potter	Southern	Washington, D. C.
Percy Hewitt	Sou. Pac.	Houston, Texas.
E. Parsons	Illinois Central	Chicago, Ill.
E. E. McClintock	C. & W.	Denver, Colo.
W. J. Camp	C. P.	Montreal, Canada.
E. W. Day	B. & O.	Baltimore, Md.
B. Weeks	Illinois Central	Memphis, Tenn.
J. C. Browne	St. L. I. M. & S.	Little Rock, Ark.
F. E. Bentley	T. R. R. Assn.	St. Louis, Mo.

ASSOCIATE MEMBERS

[illegible]	New York
[illegible]	Chicago
[illegible]	[illegible]
[illegible]	New York
[illegible]	New York
[illegible]	Chicago
[illegible]	New York
[illegible]	New York
[illegible]	Philadelphia
[illegible]	New York
[illegible]	New York
[illegible]	New York
[illegible]	New York
[illegible]	Boston
[illegible]	Chicago
[illegible]	Milwaukee

HONORARY MEMBERS

Thos. A. Edison	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
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[illegible]	Geo. T. Williams
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CONSTITUTION

ARTICLE I.

Title.

The organization shall be known as "The Association of Railway Telegraph Superintendents."

ARTICLE II.

Object.

The object of this Association shall be : "The Improvement of the Telegraph Service," and the promotion and advancement in general of the interests of the telegraph department of railroads.

ARTICLE III.

Who may be Members.

Sec. 1. The membership of the Association shall be of three classes: Active, Associate and Honorary.

Sec. 2. Who may be Active Members:

Anyone connected in an official capacity with the telegraph, telephone, electric light, electric power, or electric signal department of any railroad, may become an Active Member of this Association, by subscribing to the Constitution and paying into the Treasury $5.00 per annum and receiving a majority vote of the members present.

Sec. 3. Who may be Associate Members:

Anyone connected with a telegraph or telephone supply house or publication may become an Associate Member, subject to receiving a majority vote of the members present and paying into the Treasury $5.00 per annum.

Associate Members shall be entitled to all the rights and privileges of Active Members, except that they shall not be allowed to vote.

ASSOCIATE MEMBERS

A. P. Eckert.....New York.
C. E. Brown.....Chicago.
W. H. Adkins.....Atlanta.
C. E. Yetman.....New York.
G. W. Conklin.....New York.
E. W. Vogel.....Chicago.
J. J. Ghegan.....New York.
M. J. O'Leary.....New York.
J. H. Reid.....Philadelphia.
B. A. Kaiser.....New York.
John Brant .....New York.
C. A. Adams-Randall.....New York.
F. F. Fowle.....New York.
H. B. Kirkland.....Boston.
H. O. Rugh.....Chicago.
W. S. Burnett.....Milwaukee.

HONORARY MEMBERS

Thos. A. Edison.
T. D. Lockwood.
Ralph W. Pope.
J. C. Barclay.
J. J. Burns.
J. B. Stewart.
A. J. Earling.
C. H. Bristol.
C. E. Freeman.
W. E. Ahearn.
Wm. Maver, Jr.
Geo. C. Maynard.
W. K. Morley.
W. S. Logue.
F. P. Valentine.
W. E. Gilmore.
J. M. Stephens.
H. V. Miller.
H. F. Houghton.
J. F. Wallick.
J. Levin.
J. R. Terhume.
James Kent.
G. F. Weidman.
J. H. Jacoby.
R. C. Clowry.
W. C. Brown.
Geo. W. Stevens.
Marvin Hughitt.
W. M. Greene.
T. P. Cook.
F. S. Gannon.
Geo. T. Williams.
Belvidere Brooks.
I. N. Miller.
J. B. Tree.
T. R. Taltavall.
J. W. Fortune.
W. J. Murphy.
C. D. Gorham.
Charles McLaughlin.
J. B. Taltavall.
E. A. Smith.
C. G. Sholes.
J. H. Hill.
A. R. Swift.
K. McKenzie.
E. Borden.
F. E. Clary.
C. A. Darlton.

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Sec. 4. Who may be Honorary Members:

Men prominent in Railway Telegraph or Telephone circles, and those who have by furnishing papers and otherwise contributed to the success of the Association, and any Active Member, who is in good standing as to payment of dues, leaving the service of railroad companies or of the departments mentioned in Sec. 2, may become an Honorary Member upon receiving a majority vote of members present. Honorary members shall be entitled to all the rights and privileges of Active Members except that they shall not be allowed to vote.

ARTICLE IV.

Officers.

The officers of this Association shall be elected by ballot, and shall hold office for one year, or until their successors are chosen. They shall consist of a President, Vice-President, Secretary and Treasurer; the last two offices may be filled by one person. The officers of this Association shall constitute an Executive Committee.

ARTICLE V.

Duties of Officers.

President—The President shall preside at all meetings of the Association, and perform such other duties as are generally performed by that officer.

Vice-President—The Vice-President shall preside in the absence of the President, and when so acting shall be governed by the rules prescribed for that officer.

Secretary—The Secretary shall keep correct minutes of each meeting, and cause the same to be printed immediately after adjournment, and send to each member two copies of the same. He shall also notify the members, by circular, of the time and place of each meeting, and perform such other duties as may be required by the Executive Committee.

Treasurer—The Treasurer shall collect all moneys due the Association, giving his receipt therefor, pay all bills contracted for by it, upon the approval of the Executive Committee, and at each annual meeting render a detailed statement of the receipts and expenditures of the previous year, which statement shall be printed with the proceedings of the meeting at which it is presented. In order to meet expenses in excess of the receipts from annual dues, he shall levy a pro rata assessment upon the members of the Association.

ARTICLE VI.

Vacancies.

In case of a vacancy in any office, it shall be filled for the remainder of the year by the Executive Committee.

ARTICLE VII.

Meetings.

Seven members shall constitute a quorum at any meeting.

Amendments to the Constitution.

This constitution shall be changed only by an amendment offered in writing at a regular meeting, one month's notice having been given to each member by the Executive Committee, and can only be adopted by an affirmative vote of two-thirds of the members present.

BY-LAWS

1. The Executive Committee is authorized to declare applicants acting members previous to the annual meeting.

2. The annual meeting of this Association shall be held at such time and place as shall be designated by the majority vote of members at a previous meeting.

3. Special meeting may be held upon the call of the Executive Committee, when requested by seven or more members.

4. Any member who is in arrears in payment of dues ninty days after the annual meeting shall be considered suspended, and should dues not be paid on or before the succeeding annual meeting, his name shall be dropped from the roll of membership.

ORDER OF BUSINESS

At all meetings the following shall be the order of business:

1. Election of New Members.
2. Reading the Minutes of Regular and Special Meetings.
3. Report of Treasurer.
4. Reports of Standing Committees.
5. Reports of Special Committees.
6. Election of Officers.
7. Miscellaneous Business.
8. Adjournment.

Minutes of the Proceedings of the Twenty-fourth Annual Convention, Association of Railway Telegraph Superintendents, held at Chattanooga, Tenn., May 17th and 18th, 1905

Secretary Drew: Before the Committee on Arrangements makes their report, after which the ladies will probably want to go, I will distribute the attendance cards so that we will be sure to get the proper name and address of everyone present, and have this correct for our minutes. This is a very important matter so far as the secretary is concerned. Those who are accompanied by their wives or daughters or sisters, or anybody else's daughter or sister, put that down too.

Present:

C. Selden	B. & O.	Baltimore, Md.
H. C. Hope & Daughter.	C. St. P. M. O.	St. Paul, Minn.
E. E. Torrey	M. & O.	Jackson, Tenn.
G. L. Lang	Q. & C.	Chattanooga, Tenn.
E. A. Chenery & Wife.	M. P.	St. Louis, Mo.
C. P. Adams	Southern	Washington, D. C.
W. F. Williams, Wife and Daughter	S. A. L.	Portsmouth, Va.
W. W. Ryder & Wife	C. B. & Q.	Chicago, Ill.
Geo. M. Dugan	I. C.	Chicago, Ill.
G. C. Kinsman, Wife & Sister	Wabash	Decatur, Ill.
P. W. Drew & Wife	W. C.	Milwaukee, Wis.
S. K. Bullard & Wife.	M. K. & T.	Sedalia, Wis.
P. Hewitt & Wife	S. P.	Houston, Texas.
B. F. Frobes & Wife	O. S. L.	Salt Lake City, U.
L. B. Foley & Wife	D. L. & W.	New York City.
E. P. Griffith, Wife & Daughter	Erie	Jersey City, N. J.
G. H. Groce	I. C.	Chicago, Ill.
F. H. Van Etten	C. & E. I.	Danville, Ill.
W. J. Camp & Wife	C. P.	Montreal, Que.
V. T. Kissinger & Wife.	C. B. & Q.	Lincoln, Neb.
E. Parsons	I. C.	Chicago, Ill.
J. S. Stevens	C. & O.	Richmond, Va.
F. S. Spafard & Wife.	C. R. I. & P.	Chicago, Ill.
R. L. Logan	K. C. S.	Kansas City, Mo.
W. P. Cline	A. C. L.	Wilmington, N. C.
B. Weeks	I. C.	Memphis, Tenn.

W. C. Walstrum	N. & W.	Roanoke, Va.
J. Levin, Wife & Sister	W. U. Tel. Co.	Atlanta, Ga.
I. N. Miller & Wife	W. U. Tel. Co.	Cincinnati, Ohio.
C. H. Bristol	W. U. Tel. Co.	New York City.
D. R. Davies	W. U. Tel. Co.	Chicago, Ill.
W. A. Neill	W. U. Tel. Co.	Atlanta, Ga.
M. J. O'Leary	T. M. B. Ass'n	New York City.
C. E. Brown	Cent Eelctric Co.	Chicago, Ill.
W. S. Logue & Wife	Edison Mfg. Co.	New York City.
A. P. Eckert, Wife & Sister	Safe, Ins. Wire C. Co.	New York City.
F. F. Fowle	A. T. & T. Co.	New York City.
B. A. Kaiser & Wife	M. & K. Telep. Co.	Kansas City, Mo.
Wm. Maver, Jr., & Wife		New York City.
E. W. Vogel & Wife	Rd. Supply Co.	Chicago, Ill.
J. R. Terhune	Western Union	Nashville, Tenn.
N. R. Fill	A. T. & T. Co.	St. Louis, Mo.
R. W. Park & Wife	Sou. Ry.	Chattanooga, Tenn.
J. S. Greever	Postal	Chattanooga, Tenn.
J. B. Norris	Western Union	Chattanooga, Tenn.
E. L. Andrews	A. T. & T. Co.	Chicago, Ill.
A. G. Francis, Wife & Son	Chicago. Tele. Co.	Chicago, Ill.
J. B. Taltavall & Wife	Telegraph Age	New York City.
E. M. Fisher	C. T. & T. Co.	Nashville, Tenn.
J. S. Healey	W. T. & T. Co.	Chicago, Ill.
H. O. Rugh	West Teleg. Co.	Chicago, Ill.
E. M. Deens	Gordon Battery Co.	New York City.
S. A. Duncan	Post. Tel. Cab. Co.	Atlanta, Ga.
L. K. Webb	E. Tenn. Tele. Co.	Chattanooga, Tenn.
R. Brink Tyler	S. C. Teleg. Mfg. Co.	Rochester, N. Y.
Mrs. N. J. Tidby		St. Paul, Minn.
A. W. Chambliss	May. of Chattanooga	Chattanooga, Tenn.

President: I will ask Mr. Lang if the Committee on Arrangements is ready to report.

Mr. Lang: The plan as outlined by your Committee, of course subject to the adoption or rejection by the meeting, is that after our morning session to-day and after lunch, we go to Lookout Mountain. The Management of the Rapid Transit Electric Co., which includes the incline, have very kindly offered us a round trip excursion, complimentary, but I must know in a very few minutes how many will take the trip this afternoon, to get the necessary transportation. This evening we might find it pleasant to go out to Olympia Park, where there is an open air theater. Some such a place as we visited in Indianapolis you will remember, where Mr. O'Leary and one or two others rode the horses around. To-morrow morning, as I understand it, we will get to business just as soon as we can and work hard all day, hoping to complete our work to-morrow, figuring on no entertainment for the men at all to-morrow. The Chattanooga Electric Railway Co. kindly offers a special car for the ladies to Missionary Ridge. The conductor is one of their oldest employes and is thoroughly posted on the points of interest on the Ridge and will act as guide for the ladies. I think this meeting was cut short one day. Chattanooga is something like Washington, a city of magnificent distances. We cannot see it in a minute, but I shall be very glad to have all the members and those accompanying them stay here Friday and we will make an excursion to the army post Fort Oglethorpe and beyond that to Chickamauga Park, taking in the prominent points of interest. Have lunch at the Dyer House and return in time to leave Friday night. There is one point which I wanted to bring out right here, which is that your committee has followed the precedent established years ago of allowing every member to pay his own way. We have not gone before the people of Chattanooga begging money to entertain you. I know personally and from the members that nothing of that kind was desired. Every man will pay his own way. Any public facilities we can get, like street cars and steamboats, will

be gladly accepted, but when it comes to begging money of the people to entertain you, we are not built that way. The drive to Chickamauga Park will be $1.00 each way. We will go by way of the National Cemetery, Missionary Ridge and the Army Post.

President: Now if everything is arranged and there is nothing further for the ladies, we will excuse them.

Mr. Lang: There is one matter that I overlooked entirely that you all ought to know about. The telegraph companies have both extended the courtesies of their lines to members of the Association, the East Tennessee Telephone Co. and the American Telephone and Telegraph Co. have placed a booth a little in front of the elevator, and request that we leave our calls, and we will find it very much to our interest if we will do so. Then come back at a certain hour when we expect our party, and take up no time. The telephone companies were particularly courteous and insist on our using their lines all we please.

Secretary: Perhaps, Mr. President, it would be just as well for us to read these letters so that all may know to whom we are indebted.

President: I think that would be advisable, Mr. Secretary.

Secretary: The Postal Telegraph Co. wires us from Atlanta, Ga.:

"The Postal Telegraph-Cable Co. desires to extend with its companies the free use of its lines for the personal and social messages of the members of the Association of Railroad Telegraph Superintendents during your annual meeting at Chattanooga. Confirmation of this will be mailed to you in care of our manager at Chattanooga.

G. E. PAINE."

The Western Union Telegraph Co. also extends their courtesies. We have not received yet the formal announcement, but it will be here in a few hours.

Mr. Fowle, the Special Agent Railway Department of the American Telephone and Telegraph Co. of New York, writes:

Association of Railway Telegraph Superintendents.

Twenty-Fourth Annual Convention.

The Twenty-fourth Annual Convention of the Association of Railway Telegraph Superintendents was held at the Read House, Chattanooga, Tennessee, commencing on the 17th day of May, 1905. The convention was called to order at 10 A. M. by the President, Mr. H. C. Hope.

President: Ladies and Gentlemen, we are now about to call to order the twenty-fourth annual session of the Association of Railway Telegraph Superintendents. The President will not take up the time by trying to make an address this morning, but I am going to introduce to you one of the past presidents of the Association, one of the oldest members, Col. Geo. L. Lang.

Mr. Lang: Ladies and Gentlemen, last year you remember I told you at Indianapolis, in my argument trying to persuade you to come to Chattanooga, that the air was purer, the sky was bluer, and the girls sweeter in Chattanooga than anywhere else on earth. Now the time has come for me to make good. I can only do so by proxy. I wish to introduce to you Mr. A. W. Chambliss, mayor of Chattanooga.

Mayor Chambliss: Mr. President, Ladies and Gentlemen: I am a messenger boy. I am very happy to be a messenger boy, carrying a message from the hearts of our people to your hearts I trust, a sort of wireless telegraphy, don't you know. It gets there all the same, if we understand each other and appreciate each other, as I am sure we will if you stay with us long enough. It is not a written message. Your distinguished ex-president asked me just a moment ago if I had my address written out. I told him that I had not been able to prepare a written address, and really, when I prepare one I don't know just what to say until I have seen you anyway. I might prepare something to say

which would not suit you after I had seen you. We have all sorts of people coming here. I might prepare something for one party that would not suit another, and more than that, somehow written words are not quite so effective it seems to me. My father who is a minister, preached at one time in Charleston, South Carolina, and the story goes that he one time met a colored preacher and said to him, "Uncle Jake, things are a little cold over at my church. My congregation is not quite so responsive as yours. When you get out and pass by and hear what is going on you rouse things. They applaud and cheer and seem to enjoy things immensely. It seems to do them good. What is the secret of it?" He said, "Now look a' here sah, you writes out your sermons don't you?" I said, "Yes I do." "Well let me tell you about that. While you write out your sermons the devil is looking over your shoulder and he is taking in everything you write, and before you get up before the congregation he has been around and posted up everybody in the congregation, and you don't do no good at all. Now as for me, when I goes into the pulpit Sunday morning and open the bible and takes up my text, neither the devil nor myself know what I am going to say."

And yet I feel, gentlemen, as if I ought to be more particular than usual in addressing a convention or association of men who have to do with telegraphy, because you are particular about what you say, and it is very important that you make no mistake. You recognize the importance of exactness in what is said Now you know that the transposition of a few letters makes a very serious difference sometimes. I know a friend of mine who was about to be married and was somewhat embarrassed (I don't know why a man should be embarrassed under those circumstances), turned to his leading man and said, "I forgot to ask you if it is kisstomary to cuss the bride." It makes a great deal of difference how you put the thing. I don't want to make any mistakes of course. I hope you will bear with me if I should, and I offer that much by way of apology for not writing, although as I say, I feel that perhaps it would have been better

for me to have written something. You run the railroads; are understood pretty generally to run the country. Or you were running it until Mr. Roosevelt took a hand. I have an impression that you run in a large measure the railroads, and—(with a gesture toward the ladies)—I also have an impression that there are some people who run you. If I see lines in your fine faces gentlemen, I know how to account for them. Seriously, you do occupy very responsible positions in life, and you feel the burden of those responsibilities. It is a happy thing that once a year you can go to some pleasant spot, like this for instance, and recreate both physically and mentally. Gain something bodily and physically, I say, and also gain something mentally, by your association and contact of mind. I am happy to know that you have chosen Chattanooga. When I meet strangers coming here in conventions as you come, I find myself at a loss sometimes to know whether it is better for me to talk about you or ourselves. You know sometimes people like to talk about themselves, and they like to hear themselves talked about better than they like to hear other things discussed, and I don't know how this particular gathering feels about that. I could talk to you and say a great many things complimentary and also true. (I am looking at this side now,—the ladies.) When I come to discuss Chattanooga, I confess I am in despair. It is not because I am ignorant of what I am about to talk of, but I feel myself utterly unable to describe the beauties of the situation. Sam Jones said a short time ago that he didn't want to hear the doctors talk so much. He said: "Take me out to the cemetery and show me what you have done." And so I come to feel that way about Chattanooga. It is of no use for me to talk to you about these things. I can take you out here and show you things that you never saw before. Here is Lookout Mountain. You will not fail to go up there. A trip up the incline has a very elevating influence. You see a great deal more and it makes you wiser and better men. No man climbs that mountain, 1600 feet, without feeling that there are some things in his life that need

correction. I went out and started up the mountain and a handsome, fine looking gentleman was standing on the platform; a man who looked as though he had never had any trouble with his digestion at all. He said to me, "Is there a place up there where I can get something to eat? As I have only a few hours in the city and was in a hurry this morning I did not have time to get my breakfast." I said: "Yes, I will show you a place where you can get something to eat." After we had reached the top, I saw him leaning against a post or shed, and I said to him, "Now my friend, I shall be glad to show you a place where you can get something to eat." He looked at me in an absent sort of way, and then seeming to recover himself said, "Excuse me; I don't think I shall want anything to eat for two weeks." Nevertheless you should not miss the trip. You can stand there and see as many glorious things as Satan showed the Lord, from that glorious height. I am not going up there and show you anything,—the parallel will fail to that extent at least. Then we have Missionary Ridge over here on the other side, made famous in history, and down below Chickamauga. And right here we have Chattanooga, filled with enterprising good people. There are four hundred manufacturing industries at work all about us and within us. You will find all of those things of interest, and I hope you will be charmed by them. Now more than the mere scenic interest, more than the mere matter of temperature,—by the way, I must say that you can imbibe all of this good air that you like. I said to the Photographers Association when they were here last year that they were perfectly free to "take" anything they saw and "catch" it. I don't know whether I can make the same proposition to you, because you might take it away with you, but the air—you may take that. We will not begrudge it to you. A darkey was injured on the railroad here a short time ago. The first doctor who got to him was a colored friend. He was not exactly satisfied. The railway surgeon came in and said, "Abe, did that other doctor take your temperature?"

Secretary Drew: Before the Committee on Arrangements makes their report, after which the ladies will probably want to go, I will distribute the attendance cards so that we will be sure to get the proper name and address of everyone present, and have this correct for our minutes. This is a very important matter so far as the secretary is concerned. Those who are accompanied by their wives or daughters or sisters, or anybody else's daughter or sister, put that down too.

Present:

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E. E. Torrey	M. & O.	Jackson, Tenn.
G. L. Lang	Q. & C.	Chattanooga, Tenn.
E. A. Chenery & Wife.	M. P.	St. Louis, Mo.
C. P. Adams	Southern	Washington, D. C.
W. F. Williams, Wife and Daughter	S. A. L.	Portsmouth, Va.
W. W. Ryder & Wife	C. B. & Q.	Chicago, Ill.
Geo. M. Dugan	I. C.	Chicago, Ill.
G. C. Kinsman, Wife & Sister	Wabash	Decatur, Ill.
P. W. Drew & Wife	W. C.	Milwaukee, Wis.
S. K. Bullard & Wife.	M. K. & T.	Sedalia, Wis.
P. Hewitt & Wife	S. P.	Houston, Texas.
B. F. Frobes & Wife	O. S. L.	Salt Lake City, U.
L. B. Foley & Wife	D. L. & W.	New York City.
E. P. Griffith, Wife & Daughter	Erie	Jersey City, N. J.
G. H. Groce	I. C.	Chicago, Ill.
F. H. Van Etten	C. & E. I.	Danville, Ill.
W. J. Camp & Wife	C. P.	Montreal, Que.
V. T. Kissinger & Wife.	C. B. & Q.	Lincoln, Neb.
E. Parsons	I. C.	Chicago, Ill.
J. S. Stevens	C. & O.	Richmond, Va.
F. S. Spafard & Wife.	C. R. I. & P.	Chicago, Ill.
R. L. Logan	K. C. S.	Kansas City, Mo.
W. P. Cline	A. C. L.	Wilmington, N. C.
B. Weeks	I. C.	Memphis, Tenn.

W. C. Walstrum	N. & W.	Roanoke, Va.
J. Levin, Wife & Sister	W. U. Tel. Co.	Atlanta, Ga.
I. N. Miller & Wife	W. U. Tel. Co.	Cincinnati, Ohio.
C. H. Bristol	W. U. Tel. Co.	New York City.
D. R. Davies	W. U. Tel. Co.	Chicago, Ill.
W. A. Neill	W. U. Tel. Co.	Atlanta, Ga.
M. J. O'Leary	T. M. B. Ass'n	New York City.
C. E. Brown	Cent Eelctric Co	Chicago, Ill.
W. S. Logue & Wife	Edison Mfg. Co.	New York City.
A. P. Eckert, Wife & Sister	Safe, Ins. Wire C. Co.	New York City.
F. F. Fowle	A. T. & T. Co.	New York City.
B. A. Kaiser & Wife	M. & K. Telep. Co.	Kansas City, Mo.
Wm. Maver, Jr., & Wife		New York City.
E. W. Vogel & Wife	Rd. Supply Co.	Chicago, Ill.
J. R. Terhune	Western Union	Nashville, Tenn.
N. R. Fill	A. T. & T. Co.	St. Louis, Mo.
R. W. Park & Wife	Sou. Ry.	Chattanooga, Tenn.
J. S. Greever	Postal	Chattanooga, Tenn.
J. B. Norris	Western Union	Chattanooga, Tenn.
E. L. Andrews	A. T. & T. Co.	Chicago, Ill.
A. G. Francis, Wife & Son	Chicago. Tele. Co.	Chicago, Ill.
J. B. Taltavall & Wife	Telegraph Age	New York City.
E. M. Fisher	C. T. & T. Co.	Nashville, Tenn.
J. S. Healey	W. T. & T. Co.	Chicago, Ill.
H. O. Rugh	West Teleg. Co.	Chicago, Ill.
E. M. Deens	Gordon Battery Co.	New York City.
S. A. Duncan	Post. Tel. Cab. Co.	Atlanta, Ga.
L. K. Webb	E. Tenn. Tele. Co.	Chattanooga, Tenn.
R. Brink Tyler	S. C. Teleg. Mfg. Co.	Rochester, N. Y.
Mrs. N. J. Tidby		St. Paul, Minn.
A. W. Chambliss	May. of Chattanooga	Chattanooga, Tenn.

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P. Hewitt & Wife	S. P.	Houston, Texas.
B. F. Frobes & Wife	O. S. L.	Salt Lake City, U.
L. B. Foley & Wife	D. L. & W.	New York City.
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President: I will ask Mr. Lang if the Committee on Arrangements is ready to report.

Mr. Lang: The plan as outlined by your Committee, of course subject to the adoption or rejection by the meeting, is that after our morning session to-day and after lunch, we go to Lookout Mountain. The Management of the Rapid Transit Electric Co., which includes the incline, have very kindly offered us a round trip excursion, complimentary, but I must know in a very few minutes how many will take the trip this afternoon, to get the necessary transportation. This evening we might find it pleasant to go out to Olympia Park, where there is an open air theater. Some such a place as we visited in Indianapolis you will remember, where Mr. O'Leary and one or two others rode the horses around. To-morrow morning, as I understand it, we will get to business just as soon as we can and work hard all day, hoping to complete our work to-morrow, figuring on no entertainment for the men at all to-morrow. The Chattanooga Electric Railway Co. kindly offers a special car for the ladies to Missionary Ridge. The conductor is one of their oldest employes and is thoroughly posted on the points of interest on the Ridge and will act as guide for the ladies. I think this meeting was cut short one day. Chattanooga is something like Washington, a city of magnificent distances. We cannot see it in a minute, but I shall be very glad to have all the members and those accompanying them stay here Friday and we will make an excursion to the army post Fort Oglethorpe and beyond that to Chickamauga Park, taking in the prominent points of interest. Have lunch at the Dyer House and return in time to leave Friday night. There is one point which I wanted to bring out right here, which is that your committee has followed the precedent established years ago of allowing every member to pay his own way. We have not gone before the people of Chattanooga begging money to entertain you. I know personally and from the members that nothing of that kind was desired. Every man will pay his own way. Any public facilities we can get, like street cars and steamboats, will

be gladly accepted, but when it comes to begging money of the people to entertain you, we are not built that way. The drive to Chickamauga Park will be $1.00 each way. We will go by way of the National Cemetery, Missionary Ridge and the Army Post.

President: Now if everything is arranged and there is nothing further for the ladies, we will excuse them.

Mr. Lang: There is one matter that I overlooked entirely that you all ought to know about. The telegraph companies have both extended the courtesies of their lines to members of the Association, the East Tennessee Telephone Co. and the American Telephone and Telegraph Co. have placed a booth a little in front of the elevator, and request that we leave our calls, and we will find it very much to our interest if we will do so. Then come back at a certain hour when we expect our party, and take up no time. The telephone companies were particularly courteous and insist on our using their lines all we please.

Secretary: Perhaps, Mr. President, it would be just as well for us to read these letters so that all may know to whom we are indebted.

President: I think that would be advisable, Mr. Secretary.

Secretary: The Postal Telegraph Co. wires us from Atlanta, Ga.:

"The Postal Telegraph-Cable Co. desires to extend with its companies the free use of its lines for the personal and social messages of the members of the Association of Railroad Telegraph Superintendents during your annual meeting at Chattanooga. Confirmation of this will be mailed to you in care of our manager at Chattanooga.

G. E. PAINE."

The Western Union Telegraph Co. also extends their courtesies. We have not received yet the formal announcement, but it will be here in a few hours.

Mr. Fowle, the Special Agent Railway Department of the American Telephone and Telegraph Co. of New York, writes:

"I take great pleasure in announcing to the Association of Railway Telegraph Superintendents that the American Telephone and Telegraph Co. extends to members attending the convention, complimentary service over its lines, on May 17th and 18th after 5 P. M. and before 9 A. M. Members may be identified in the usual way by their badges."

And here is one from Mr. Webb, of Chattanooga, to our Col. Lang, advising that the East Tennessee Telephone Co. extends to the Association the use of its lines during the annual meeting.

The Pullman Company writes me as follows:

"Replying to your letter 31st ult. advising that the 24th annual meeting of the Association of Railway Telegraph Superintendents will be held at Chattanooga May 17th next, beg to say that we will take pleasure in extending the same courtesy as heretofore to delegates and immediate members of their families attending the convention, namely: Upon presentation of receipts showing fares paid in our cars enroute to Chattanooga, together with the usual credentials of the Association, passes for the return trip will be issued by our agent, Mr. F. A. Barzen.

L. S. HUNGERFORD, Gen. Supt."

I called Mr. Barzen up this morning and he said that he would arrange to have his chief clerk here to-morrow about noon. I will announce the exact time at the meeting to-morrow morning, so that the Pullman pass matter can be arranged at that time.

President: Gentlemen, you have all heard these letters. The first order of business is the election of new members. Has the Secretary any applications on the table to file?

Secretary: I have the names of the following applicants for active membership:

J. L. Orbison, Supt. Tel. C. C. & L. ..... Cincinnati, O.
B. L. Frobes, Supt. Tel. O. S. Line ..... Salt Lake City, U.
E. E. Smith, Supt. Tel. N. Y. N. H. & H. ..... New Haven, Conn.
E. W. Day, As. S. Tel. B. & O. ..... Baltimore, Md.
B. Weeks, As. S. Tel. Ill. Cent. ..... Memphis, Tenn.
J. M. Walker, A. S. Tel. D. & R. G. ..... Denver, Col.
J. C. Browne, Gen. Form. St. L. I. M. & S. Ry. Little Rock, Ark.

The following for associate membership:

J. H. Reid ..... Am. Elec. Teleg. Co. ..... Philadelphia.
John Brant ..... W. U. T. Co. 195 Broad. . New York.
F. F. Fowle ..... A. T. & T. Co. ..... New York.
H. O. Rugh ..... W. Tel. Co. ..... Chicago.
W. S. Burnett ..... Morse Code Sig. Co. ..... Milwaukee.
H. B. Kirkland ..... Am. Circ. Loom Co. ..... Boston.

If there are no other names to be offered for active or associate membership, Mr. President, I submit these names and move that they be elected.

President: Gentlemen, you have heard the list of names offered for active and associate members, and it is moved that these names be elected. All in favor say aye, contrary no. Carried.

Secretary: The following names are offered for honorary membership:

G. F. Weidmann ..... Houghton, Mich.
Col. R. C. Clowry ..... Pres. and Gen. Mngr. W. U. Tel. Co.
J. C. Barclay ..... Asst. Genl. Mgr., W. U. Tel. Co., New York.
Marvin Hughitt ..... Pres. C. & N. W. Ry., Chicago.
J. R. Terhune ..... Dist. Supt. W. U. Tel. Co., Nashville.
J. Levin ..... Gen. Supt. Southern Div., W. U. Tel. Co., Atlanta, Ga.
J. H. Jacoby ..... South Bethlehem, Pa.
T. P. Cook ..... Gen. Supt., W. U. Tel. Co., Chicago.
Belvidere Brooks ..... Gen. Supt., W. U. Tel. Co., New York.
James Kent ..... Mngr. Canadian Pac. Tel. System.

President: All in favor of these names the Secretary has read on our honorary list please say aye, contrary no. I declare them elected.

The reading of the minutes of the regular and special meeting will be dispensed with if there is no objection, as copies have been distributed to all the members.

The next in order is the report of the Treasurer.

The Treasurer reads his report as follows:

TREASURER'S REPORT.

RECEIPTS.

Balance from last year	$ 3.85
Fees and dues	305.00
Advertisements	198.00
Copies of minutes sold	22.00
Total	$528.85

EXPENDITURES.

Postage, exchange and express	$ 24.01
Minutes	168.74
Printing notices	12.00
Badges	8.00
Secretary's salary	300.00
Balance on hand	16.10
Total	$528.85

President: Gentlemen you have heard the report of the Treasurer. Any remarks?

Mr. Kinsman: I move the report be accepted.

Motion seconded.

President: It is moved and seconded that the report of the Treasurer be accepted. All in favor say aye, contrary no. The report is accepted.

Reports of standing committees. The Committee on Arrangements has reported. Committee on Topics, Mr. Little, chairman, being absent, I will say for him that he expected to be here, but the general superintendent, Cook, started for a trip

over the Northern Pacific and Great Northern, which stopped both Mr. Greene and Mr. Little from coming.

We have a paper by Mr. Frank F. Fowle, of the Railway Department of the American Telephone and Telegraph Co. I think we had better take up Mr. Fowle's paper if he is here. Are you ready Mr. Fowle?

Mr. Fowle: Yes sir.

Secretary: We have printed copies of Mr. Fowle's paper that can be distributed to those who have not brought their copies with them. Mr. Fowle had these printed, he does not care to read the article, but would like to make some remarks about it and have that take the place of reading the paper. It will save us quite a little time. I am very glad that Mr. Fowle did this.

THE RAILWAY TELEPHONE SERVICE; COST OF LINE CONSTRUCTION.

BY

FRANK F. FOWLE

Special Agent, Railway Department, American Telephone and Telegraph Co.

The ownership and operation of private telephone lines by railway companies is a proposition which differs essentially from the public exchange and toll business. There are three distinct differences which place the railway telephone service in a seperate class, namely:—the service is not operated for direct revenue, it is only an auxiliary in the railway business and the nature of the traffic permits discriminations and very quick service. Since the telephone is a competitor with the railway telegraph and the railway mail, the economy of the telephone is interwoven with the cost of the telegraph and the mail. It is generally true of the traffic of communication that the volume of traffic decreases with the length of haul and that the bulk of the traffic is short haul.

The whole question of telephone service and its economy is

secondary to the traffic, and the use of the telephone is justified when the traffic can be handled as cheaply in no other way and when the nature of the existing wire plant is such that to neglect the possibilities of simultaneous use is a waste. The traffic of communication, by telegraph and mail, should be thoroughly studied before it is decided whether the cost of telephone line construction is justified. The very short haul traffic is almost invariably handled most economically by telephone; the rapid increase in the use of private branch exchanges bears out this view. The inherent advantages of the telephone in this field are quick service and immediate answer or response; and in the class of communications of which no record is made these advantages are paramount.

Undoubtedly the mail, the telegraph and the telephone are of relatively different economy under different conditions, but there is a class for each in which its economy makes it the superior method. It is important to keep records of the traffic of communication by these three methods, in order to see that each is handling the business which it is adapted to handle most cheaply.

The railway mail probably constitutes the cheapest means of communication and its peculiar field is not likely to be invaded until the advent of the printing telegraph. The natural tendency is to abandon the mail for the telegraph and the telephone, on account of the quicker service, and one of the uses of traffic records is to detect and prevent such abuses, when the speed of the mail service is amply efficient. However, the mail service can never be better than the train service, and this point seemingly constitutes its limitation.

The entire traffic of communication is generally divisible into three main parts:—the local or short haul, the traffic over each division or the moderate haul, and the traffic between the division offices and the main offices or the long haul. The volume of the long haul traffic depends very largely on the organization of the various departments, the distribution of the organization over the road and the territory covered. The organization

of the telegraph department will naturally be one conforming to the particular requirements of any case. There are two common features in nearly all organizations, namely;—one train dispatching wire and one message wire, cut into all offices, over each division; if the division is long and the business heavy, it may be subdivided because one wire cannot handle the traffic. The long haul traffic between division headquarters and the principle offices is usually handled on wires cut into few offices, and not infrequently these wires are duplexed or quadruplexed. The cost of telegraph service rests on considerations which are quite apart from those which determine the cost of telephone service. Before discussing the question of cost it may be well to define it, as considered in this paper.

WHAT CONSTITUTES COST.

Cost may be divided into two parts, operating cost and cost of ownership. Operating cost includes labor, power, light, heat, rent and such supplies as are used in daily operation and not chargeable to plant maintenance. The cost of ownership includes the fixed charges on the entire plant, interest on first cost, depreciation, maintenance, insurance and taxes; it is customary to compute these charges on a yearly basis and give to their sum the term Total Annual Charge.

The total yearly cost of ownership and operation is the sum of the Total Annual Charge and the Total Annual Operating Cost. This cost covers the entire plant, both line and terminals. There is obviously a division of cost between line and terminals which results in the best economy; this division of cost may vary with the traffic conditions to be met, and the best economy will then be obtained by dividing the cost between line and terminals under conditions which satisfy the greater proportion of the traffic.

THE COST OF LINE CONSTRUCTION.

All discussions of the comparative cost of construction are beset with the difficulty that the market prices of material and

labor are constantly fluctuating. The average market price seems to be the only basis for comparisons which may be broadly useful; and that is the basis here used. The average price is further a safe basis in forming conclusions as to what proportion of future facilities should be included in the initial installation. As to this matter, it seems unwise to plan into the future further than the life of the vital portion of the plant,—for obvious reasons.

Following a study of the expected traffic comes the question of how much will the line cost for a given volume (or loudness) of transmission. This question, like most others, is one of increasing cost with increasing efficiency; or in other words,—for a given length of line, the louder the transmission desired, the more will it cost. Much has been said about standards of transmission, but the choice of a standard is a matter to be determined by the interests constructing the line and paying for the service. The engineer is concerned with this question only to show the relation between the volume of transmission and the cost.

Standards of transmission are usually defined as those over uniform circuits of particular construction, with only a standard telephone at either end. It is then possible, knowing the equivalents of cables and apparatus in terms of the standard circuit, to design transmission circuits to meet almost any commercial condition. Standards are very frequently stated in terms of open wire circuits of No. 8 B. W. G., and of cable circuits of No. 19 B. & S. G. The open wire lines are strung with the wires 12 inches apart; increasing the separation improves the transmission very slightly. The cable circuits are insulated with paper; increasing the capacity diminishes the efficiency. The K. R. law of transmission in cables is a simple and useful one; if R is the metallic-circuit or loop resistance per mile and K is the capacity between the two wires per mile, the talking efficiency is inversely proportional to the square root of the product K. R. For example, to double the capacity and halve the resistance

does not altar the efficiency. This law is inapplicable to open wire circuits.

High efficiency in open wire lines is secured by using low resistance wires; high efficiency in cable lines is secured by using low resistance wires and adopting a construction which will give the least capacity. The following table shows the weight of one wire per mile, for open wire circuits to talk various distances, on the assumption of several different standards.

COPPER WIRE.

Distance in Miles.	Weight per mile, for a standard of No. 8 B. W. G. of 850 Miles.	1200 Miles.	1800 Miles.
100 miles			
200 miles			
300 miles	115 lbs.		
400 miles	175 lbs.	105 lbs.	
500 miles	230 lbs.	150 lbs.	
600 miles	290 lbs.	190 lbs.	110 lbs.
700 miles	350 lbs.	230 lbs.	135 lbs.
800 miles	410 lbs.	270 lbs.	165 lbs.
900 miles	470 lbs.	310 lbs.	190 lbs.
1000 miles	530 lbs.	350 lbs.	215 lbs.
1200 miles	650 lbs.	435 lbs.	270 lbs.
1400 miles	780 lbs.	520 lbs.	325 lbs.
1600 miles	910 lbs.	610 lbs.	380 lbs.
1800 miles		695 lbs.	435 lbs.
2000 miles		785 lbs.	490 lbs.

IRON WIRE, BB GRADE.

100 miles	180 lbs.		
150 miles	450 lbs.	210 lbs.	
200 miles	750 lbs.	400 lbs.	160 lbs.
250 miles		610 lbs.	270 lbs.
300 miles			400 lbs.

The cost of construction may be computed on the basis of 15 cents per pound for copper and 3½ cents for iron, and on the assumption that pin space is available on existing pole lines. There is also a charge against the circuit for its proportion of the original cost of right-of-way and the cost of poles, cross-arms, miscellaneous material and labor; but this charge is practically independent of the questions at issue and may be omitted from comparisons.

The cost of circuits in cable is determined by the prices of copper, lead and tin and by the method of construction adopted. The great advantage of the paper-insulated cable is the fact that its low capacity makes it very much less expensive than other types. Comparing rubber with paper on the basis that the rubber cable has about three times the capacity of the paper cable, the rubber cable will require more than three times as much copper as the paper cable,—because the capacity increases with larger conductors; and rubber insulation is more expensive than paper. Paper insulation is undoubtedly the most economical for underground and permanent aerial work; rubber cable is justified only when its exposure is such that its superior insulating qualities are necessary and the extra cost may be regarded as insurance against service interruptions. Rubber insulation is superior for emergency cables and is often preferred for short submarine crossings. Paper cables are enclosed in lead sheaths to exclude all moisture and keep the paper perfectly dry. There is little advantage in sheathing rubber cables unless the thickness of rubber insulation is small and the cables are for submarine use. Aerial or underground rubber cables are usually covered with a layer of jute and then a braided covering.

Cables have been proposed with conductors insulated with rubber and then wrapped with paper; the advantages of this consist only in the advantages of rubber as an insulator, for the capacity will be practically that of conductors with insulation wholly of rubber. Cables have been proposed with the above arrangement reversed, the paper being applied first and then

covered with rubber; such a cable will be more expensive than a paper cable, for a given efficiency. The capacity will be intermediate between that of a rubber cable and that of a paper cable. One of the advantages of a paper cable is that it may be laid up loosely, thus admitting air in the lose wrappings of paper and making the capacity even lower than a tightly laid up paper cable. It will be difficult to apply rubber insulation over the paper without compressing it and excluding the air.

Telephone cables are constructed in twisted pairs to avoid cross-talk; the length of twist varies from 3 to 6 inches. There is practically no additional cost over straight wire cables and they are equally efficient, with the advantage that conductors may be used as straight single wire circuits or as twisted metallic circuits.

The folowing table gives the mileage of No. 8 B. W. G. open wire circuit which is equivalent to one mile of circuits of various gauges in paper cables of ordinary construction:

Cable Conductors.

Guage B. & S.	Mutual Capacity.	Miles of No. 8 B. W. G. which are equivalent to one mile of cable.
22	.069 mf.	45.6 miles
19	.054 mf.	28.5 miles
16	.065 mf.	22.2 miles
13	.065 mf.	15.7 miles
10	.090 mf.	13.0 miles

The cost of cables varies with a large number of conditions, but the following table shows the average cost of cables whose equivalents are given above,—in dollars per foot:

Number of pairs.	B. & S. Guage. No.				
	22	**19**	**16**	**13**	**10**
5	.037	.059	.073	.115	.148
10	.054	.083	.109	.175	.239
15	.061	.10	.139	.231	.331
20	.072	.12			
25	.083	.135	.194	.338	.492
30	.094	.15			
40	.109	.179	.273	.483	.734
50	.128	.21			

Thickness of sheath 1-12 inch.

The choice of the cable of the most economical efficiency in a given case depends on the standard of transmission, the length of open wire line, the length of cable and the number of circuits. In any given case there is a particular gauge of line wire, taken in conjunction with a particular gauge and capacity of cable, which will give the desired transmission at the least cost. The cost per circuit, for both open wire lines and cables, diminishes as the number of circuits increases.

This question of the selection of the most economical gauge of cable applies equally to bridle, office and switchboard cables; for example, the use of No. 22 B. & S. switchboard cable, in a line designed to talk 1,000 miles, is a very expensive proposition, because the same transmission could be secured with smaller line wire and larger cable, at less cost. As a general rule in cases where the burden of cost is in the open wire line, it is economy to use large gauge cables unless the cables are exceedingly short.

The terminal swithchboard arrangements are also very important in their bearing on the efficiency of transmission. Petty savings on switchboard equipment are usually obtained at the sacrifice of efficiency, and it is very important to determine that the terminal talking circuits and apparatus are adapted to the line. A comparatively small investment in securing ample transmitter-battery power will improve transmission to the same extent that many times this investment, in increasing the size of the line wires, will improve it.

SIMULTANEOUS USE OF CIRCUITS FOR TELEPHONY AND TELEGRAPHY.

There is very great economy in the simultaneous use of trunk lines for telephony and telegraphy. There are two systems in common use, the composite system and the symplex system; the former secures two telegraph circuits from one metallic telephone circuit and the latter only one telegraph circuit. The joint use is secured by introducing certain apparatus at the terminals, the

character of which is generally well known. The insertion of this apparatus impairs the line efficiency and ~~point~~ use is not economy beyond the point where the investment in increasing the size of the line wires, to offset the loss of efficiency at the terminals, exceeds the cost of an additional circuit.

One terminal set of standard composite apparatus impairs transmission to the same extent as the introduction of approximately 1.25 miles of No. 19 B. & S. gauge cable or 35.6 miles of No. 8 B. W. G. open line. The effect of two terminal sets would be equal to 71.2 miles of No. 8 B. W. G.. Therefore it is economy to composite only long trunk lines without intermediate telephone or telegraph stations.

In illustration of this, take the case of compositing a telephone line of No. 8 B. W. G. as compared with two No. 8 B. W. G. iron telegraph wires. The first cost of each circuit is given below, on the assumption that pin space is available on an existing line:

Cost of Metallic Circuit of No. 8 B. W. G. Copper.				
870 lbs. Copper	at	$ .15	per lb.....	$130.50
80 pins,	at	.01	each.....	.80
80 insulators	at	.02	each.....	1.60
80 tie wires	at	.025	each.....	2.00
10 sleeves	at	.035	each.....	.35
Labor	at	10.00	per mile...	10.00
Total cost per mile.....				$145.25

Cost of Single Wire Circuit of No. 8 B. W. G. Iron.				
378 lbs. Iron,	at	$ .035	per lb.....	$13.23
40 pins,	at	.01	each.....	.40
40 insulators,	at	.02	each.....	.80
40 tie wires,	at	.005	each.....	.20
Labor,	at	5.00	per mile....	5.00
Total cost per mile.....				$19.63

The total annual charge on each circuit is computed below, on the basis of 4 per cent. interest, 50-year useful life of copper wire and 15-year of iron; the annual cost of maintenance being principally the cost of labor, it is taken as $1.00 per mile of wire.

Annual Cost of Metallic Circuit of No. 8 B. W. G. Copper.

Interest	at 4 per cent	$5.81
Depreciation	at 2 per cent	2.91
Maintenance	at $1.00 per mile of wire	2.00
Taxes	at 1 per cent	1.45
	Total Annual Charge	$12.17

Annual Cost of Single Wire Circuit of No. 8 B. W. G. Iron.

Interest	at 4 per cent	$ .79
Depreciation	at 6.7 per cent	1.32
Maintenance	at $1.00 per mile of wire	1.00
Taxes	at 1 per cent	.20
	Total Anual Charge	$3.31

The annual charge on the telephone circuit must increase $6.62 on account of compositing the circuit, before it is economy to string two separate telegraph wires, and work the telephone circuit uncomposited. This resolves itself into a question of the distance between telegraph stations. An increase of $6.62 in the annual charge on the telephone circuit may be regarded as the interest, depreciation and taxes at 7 per cent on the additional copper,—needed to maintain the efficiency of the telephone circuit. This amount capitalized is $94.57 and will pay for 630 lbs. of additional copper,—or a 750 lb. wire instead of a 435 lb.

In designing a 1,200 mile line, on the 1,200 mile standard, it would be economy to introduce not more than six composited sections; giving telegraph service thereby, between the two terminals and five intermediate telegraph offices. The economy

of the composite is less apparent with a better standard of transmission; but the economy on short-haul circuits, of less cost, is more apparent. The efficiency of the composite from a telephone standpoint exceeds the efficiency from a telegraph standpoint, for a telegraph circuit through twelve composite sets would not be satisfactory. The composite system is limited by the fact that an intermediate telephone station requires the same composite apparatus that is required at an intermediate telegraph station. Ringing over such circuits is accomplished by the use of special high frequency ringers. The question of economy may be summed up in the statement that the composite system is best adapted to circuits of moderate or great length, on which the telephone traffic and the telegraph traffic are of a through nature, or direct business between terminals.

The symplex system is somewhat more flexible, but does not present the same economy of line as the composite. There are two types of symplex apparatus, one of which employs a repeating coil and the other a bridged impedance; the latter is the more efficient. The repeating coil method is employed when grounded ringing generators may be connected to the line, which otherwise would ground the telegraph circuit and chatter the relays; this method has advantages under certain conditions, but is not the most economical for long lines. The effect of a repeating coil of the most efficient type, introduced in the line at the terminal, is equivalent to the introduction of one mile of No. 19 B. & S. gauge cable, or 28.5 miles of No. 8 B. W. G. open line. The effect of the bridged symplex may be considered as equivalent to 0.25 mile of cable. Considering the former case of a 1,200 mile line of No. 8 B. W. G. copper, it will be economy to introduce symplex apparatus until the annual charge per mile of line exceeds $15.48; the increase of $3.31 capitalized at 7 per cent. is $48.14 and will permit increasing the weight of the wire to 595 lbs. per mile. A 595-lb. wire will talk 1,570 miles and the margin over 1,200 miles is 370 miles of the 595-lb. wire or 280 miles of 435-lb. wire. It will be economy to symplex such a line pro-

vided the number of symplexed sections does not exceed 20. Intermediate telephone stations bridged on the line require no symplex apparatus, and this feature adapts the symplex system to short lines handling way (telephone) business. An intermediate telegraph station, at which there is no telephone, may be equipped with a repeating coil if the station is not near either terminal, because the introduction of an efficient coil has less effect if the coil is in the center of the line.

The symplex system adapts itself to a greater range of traffic conditions than the composite, but it is especially adaptable to circuits handling way business, either telephone or telegraph. The morse side of the composite system may be worked single or duplex and on the symplex system it may be worked single, duplex or quadruplex.

CIRCUITS WHOLLY IN CABLE.

For distribution from private exchanges the use of cable is economical if a considerable number of circuits follow one route. On the basis that it is not advisable from a mechanical standpoint to string copper wire weighing less than 150 lbs. per mile, it follows that No. 22 gauge cable becomes economy for more than 10 circuits, No. 19 gauge for more than 15, and No. 16 for more than 20. This conclusion is arrived at on the basis that a circuit of 150-lb. copper costs per mile:

300 lbs. copper	at	$ .15	per lb.....	$45.00
80 pins	at	.01	each.....	.80
80 insulators	at	.02	each.....	1.60
80 tie wires	at	.01	each.....	.80
10 sleeves	at	.025	each.....	.25
Labor	at	10.00	per mile	10.00
Total cost per mile.....				$58.45
Total Annual Charge.....				6.09

The cost of aerial cable per mile is computed as:

15 Pair No. 19 Gauge Cable.

5280 ft. cable at $ .10 per foot	$528.00
5280 ft. supporting strand at $ .01 per foot	52.80
3000 cable hangers at $ .005 each	15.00
40 suspension clamps at $ .05 each	2.00
10 guy clamps at $ .10 each	1.00
Labor	150.00
Total Cost per mile	$748.80

and the annual charge is computed on the basis

Interest	at 4 per cent	$29.95
Depreciation	at 5 per cent	37.44
Maintenance	at $15.00 per mile	15.00
Taxes	at 1 per cent	7.49
Total Annual Charge		$89.88
Total Annual Charge per mile of circuit		5.99

Cables of No. 13 and No. 10 gauge are suitable only for use in connection with long haul circuits, but are the most economical for such work. It is good practice to employ cables having conductors of several gauges and such cables are in use, having No. 19, No. 16 and No. 13 gauge conductors.

If the cable had been compared with open metallic circuits of No. 10 B. W. G. iron wire, the point at which cable becomes economy would not have been reached for as low a number of pairs as in the case of the 150-lb. copper circuit: the annual charge on the iron circuit of No. 10 B. W. G. is $5.54 per mile.

The use of loading coils for improving transmission, as shown to be possible by Dr. M. I. Pupin, is of great economy for long circuits in cable. There is usually no advantage in loading circuits less than 5 miles in length, and loading should be confined to trunk lines. There are few railroad conditions where

loading would be of material benefit at present. The loading of open wire lines is not advisable except for circuits of small gauge,—and relatively low efficiency for long haul work; considerable improvement may be obtained by loading such circuits. The improvement is obtained only for relatively long circuits and the gain is not so apparent when such circuits are operated in short sections, because of the harmful effect of bridges on the circuit at intermediate offices.

The loading of large gauge, open-wire lines is not advisable because such circuits are already very efficient and because whatever improvement may be obtained is dependent on high insulation of the line; and low insulation not only impairs the efficiency of the loading, but so impairs it under the conditions of very poor insulation that the loading is a detriment to transmission.

LAYOUT AND DESIGN OF CIRCUITS.

The design of circuits to meet a particular set of conditions is a problem which may be solved with a precision equal to that in all ordinary engineering work, but it is essentially a traffic problem, in the broadest sense. The terminal conditions are of the utmost importance and have a great bearing on the line costs. In designing a long trunk line, the various conditions which affect the efficiency of transmission should be carefully considered. The choice of the proper gauge of line wire cannot be decided until the equivalent effects on transmission have been determined for all the circuits and apparatus in the longest connection. The equivalents should be known for the sub-station lines, the switchboards, the office cables, the bridle cables, the underground, aerial, and submarine cables and the composite or symplex apparatus.

The combination of circuits in open wire with those in cable, and combinations of both with composite and symplex apparatus are so numerous that they cannot be discussed here. The problem in general is that of selecting the combinations which make the total cost a minimum, for a chosen standard of transmission.

The normal direction of telephone development is the construction of inexpensive short-haul circuits initially, the moderate-haul and long-haul circuits following in order with the growth of the telephone system. The bulk of the traffic being short-haul, this represents an economical practice, since initial expenditures meet the greater part of the traffic. There are reasons for deviating from this, in the case of long trunk-line railroads having business of a nature that demands the best means of quick communication between important trunk-line centers or terminals; it is usually necessary, in such cases, to discriminate between users, in order to prevent burdening the line with moderate-haul business.

A 1,200 mile standard of transmission over No. 8 B. W. G. circuits is probably ample for most long-haul work. When the long-haul traffic is light and originates at a limited number of telephones, it is economy to boost the transmitter batteries and to employ two receivers, in order to save line copper. The use of two receivers materially improves weak transmission.

It is important to keep way stations off long-haul circuits and in general not to load short-haul circuits with many stations. Permanently bridged stations are especially uneconomical if the traffic with them is heavy, and they are connected to circuits of any length.

USE OF EXISTING WIRE FACILITIES.

The existing wire plants of railroad systems offer an opportunity for considerable simultaneous use. The cost of reconstruction of straight telegraph wires into transposed pairs would permit of a double use of the wire plant and it would be immediately available either for telephone or telegraph service. Further than this, an alternative means of communication is then available in case of failure of the telegraph service from any cause. It would also permit of dispensing with night operators in many instances, the small night traffic being handled by telephone. Iron wires are adequate for short-haul service and would relieve

many of the existing telephone trunk lines of the burden of the short-haul traffic.

The cost of reconstruction will consist largely of the renewal of bad joints and the insertion of transpositions. The following estimate is based on the assumption that there are 8 joints and 2 transpositions per mile of circuit:

Renewal of 8 joints	at	$ .25 each	$2.00
2 Transpositions	at	.50	1.00
Total cost per mile of circuit			$3.00

This would increase the annual charge on a pair of No. 8 B. W. G. iron wires from $6.62 to $6.94 per mile, the increase of $ .32 being 10.7 per cent interest on $3.00. Such a circuit would furnish transmission equal to the 1,200 mile standard, for 195 miles; for wires which have depreciated materially this might be reduced to 150 miles. Prior to transposing it, it will be necessary to measure the pole line carefully to determine the location of transpositions. Such work, done by three men at a rate of ten miles per day, should cost about $1.50 per mile of pole line.

CIRCUIT EFFICIENCY IN HANDLING TRAFFIC.

The circuit efficiency—number of calls per day—increases with the number of circuits operated in a group to handle business over one route. The efficiency of a single circuit is usually low, but this has not been the experience in railroad work. Single trunk circuits are handling as many as 100 to 125 calls per day. As the volume of traffic over one circuit increases, the average delay on the traffic increases rapidly unless the circuit is one of a group of several circuits. Probably a traffic of 50 calls per day represents the largest traffic that can be handled without delay—giving first-class service. The use of the circuit to pass calls between the operators will occupy about 10 per cent. of the total time, leaving 90 per cent of the hour for actual circuit use.

It is important from a traffic standpoint not to bridge intermediate way offices on busy trunk lines. Party lines are not

taining when circuits are overloaded and additional facilities needed. Telephone traffic records should show date, time, origination, destination, reason for delay, length of connection or for what reason it was not established and the names of the parties or departments. Telegraph traffic records should show the date, time received, filed and transmitted, at the origination; at the destination should be shown the time received, filed and delivered. Mail records should show the date, origination, destination, train number and the departments between which the communication passed.

Traffic summaries should be prepared in two ways, one showing the daily message load on each office and the other the daily message load on each circuit .

Records or wire trouble are useful to show causes for traffic delays and also to detect bad construction, bad line conditions or lack of prompt location and removal of trouble.

Line maintenance is an important question and it is economy to employ a force sufficient to clear trouble promptly. Trouble on trunk lines and long circuits should be cleared before local office troubles, if there is necessity for a choice. If a 100 mile circuit is in trouble, on which the total annual charge is $10.00 per mile or a daily charge for 100 miles of $2.74, it is obviously economy to get the section lineman to the trouble very promptly. This point is more strongly emphasized by the attendant delay and congestion of business.

NGS WITH HIGH-TENSION POWER TRANS-MISSIONS.

ing commercial importance of transmitting power
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—and in the far West even higher,—emphasizes
uch lines. The general question of the joint
lines and subways by telephone, telegraph and

The lower terminal operating costs in the case of the telephone offset a considerable annual charge on the more expensive line circuit. On the basis of a 1,200 mile standard of transmission, the telephone is more economical than four straight morse wires for distances up to 1,650 miles; it is more economical than two duplex morse wires for distances up to 1,200 miles; and it is more economical than one quadruplex for distances up to 900 miles.

The economy of a symplexed telephone circuit, with the morse side working quadruplex as compared with two quadruplex circuits, is such that it is the most economical arrangement for distances up to 1,200 miles, or a trifle less than this if there are many intermediate exchange switchboards.

The conclusion is that the economy in wire use consists in building moderate-haul telephone lines for simultaneous use, arranged to handle the long-haul business by telegraph. When there are special uses for long-haul telephone circuits, they are no more expensive than morse circuits except for very long hauls above 1,200 miles. On railroad lines where the traffic of transportation is light or moderate, and where one train dispatching circuit and one combined business and commercial circuit are sufficient, the business can be handled most cheaply by telegraph. The very long haul traffic, also, can be handled by telegraph most cheaply. On railroad lines where there is heavy transportation traffic, it is usually the case that the traffic of communication is correspondingly large; and this is the economic field of the telephone, worked simultaneously with the telegraph.

RECORDS OF TRAFFIC AND WIRE TROUBLE.

Traffic records are of value,—as applied to the mail, the telegraph and the telephone,—in preventing abuses of the service and keeping the various classes of traffic in their respective channels, in detecting parts of the wire plant which may become idle through changes in organization or traffic methods, and in ascer-

taining when circuits are overloaded and additional facilities needed. Telephone traffic records should show date, time, origination, destination, reason for delay, length of connection or for what reason it was not established and the names of the parties or departments. Telegraph traffic records should show the date, time received, filed and transmitted, at the origination; at the destination should be shown the time received, filed and delivered. Mail records should show the date, origination, destination, train number and the departments between which the communication passed.

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CROSSINGS WITH HIGH-TENSION POWER TRANSMISSIONS.

The growing commercial importance of transmitting power electrically, over transmission lines operated at pressures as high as 33,000 volts,—and in the far West even higher,—emphasizes the danger of such lines. The general question of the joint occupancy of pole lines and subways by telephone, telegraph and

power systems is well set forth in the "National Electrical Code," of the National Board of Fire Underwriters. Class E, "Miscellaneous," Rule 64, on "Signalling Systems" and Class B, "Outside Work," Rule 12 on "Wires," and Rule 12A on "Constant Potential Pole Lines, Over 5,000 Volts," apply to all telephone and telegraph work. The telephone companies are making extensive application of various methods for protecting aerial crossings with high tension lines. Some of these methods have been described in the technical press—Electrical World and Engineer, May 21st, 1904, by Robert E. Chetwood, Jr.,—and are well worth using where the conditions permit them. Standardization of crossings is not feasible on account of the wide range of conditions to be met, but there should be a universal policy in regard to providing screens between the lines or going underground with one line, and also in regard to the minimum mechanical strength of wires, poles, crossarms, pins and insulators.

EXISTING RAILROAD TELEPHONE SYSTEMS.

The following railroad systems have extensive telephone systems, including lines of considerable length: New York Central and Hudson River Railroad, Lake Shore and Michigan Southern Railway, Illinois Central Railroad, Lehigh Valley Railroad, New York, New Haven and Hartford Railroad, Delaware, Lackawanna and Western Railroad, Chicago, Burlington and Quincy Railroad, Pennsylvania Railroad, Pennsylvania Company, Chesapeake and Ohio Railway, Baltimore and Ohio Railroad, Northern Pacific Railroad, Pittsburg and Lake Erie Railroad and Long Island Railroad.

The largest gauge wire is No. 8 B. W. G. and the smallest is No. 10 B. & S. for aerial work. Considerable use of composite and symplex systems is made. The longest transmission is from New York to Chicago, 960 miles, over the New York Central and Hudson River Railroad and the Lake Shore and Michigan Southern Railway. The total mileage of telephone circuit is approximately 6,000 miles, excluding very short lines and station circuits.

APPENDIX—WIRE TABLE.

Lbs. per mile of copper wire.	Gauge B. & S. G.	B. W. G.	N. B. S. G.
10.2 lbs.	No. 22		
12.5 lbs.		No. 22	No. 22
13. lbs.	No. 21		
16.4 lbs.	No. 20	No. 21	No. 21
19.6 lbs.		No. 20	
20.7 lbs.	No. 19		No. 20
25.6 lbs.	No. 18		No. 19
28.2 lbs.		No. 19	
32. lbs.	No. 17		
36.8 lbs.			No. 18
38.4 lbs.		No. 18	
42. lbs.	No. 16		
50. lbs.			No. 17
52. lbs.	No. 15		
54. lbs.		No. 17	
65. lbs.	No. 14		No. 16
68. lbs.		No. 16	
83. lbs.	No. 13	No. 15	No. 15
102 lbs.			No. 14
105. lbs.	No. 12		
110. lbs.		No.14	
132. lbs.	No. 11		
135 lbs.			No. 13
144. lbs.		No. 13	
166. lbs.	No. 10		
173. lbs.			No. 12
190. lbs.		No. 12	
208. lbs.	No. 9		
215. lbs.			No. 11
230. lbs.		No. 11	
262. lbs.	No. 8		No. 10
287. lbs.		No. 10	

331.	lbs.	No. 7		No. 9
350.	lbs.		No. 9	
409.	lbs.			No. 8
419.	lbs.	No. 6		
435.	lbs.		No. 8	
495.	lbs.			No. 7
518	lbs.		No. 7	
529.	lbs.	No. 5		
589.	lbs.			No. 6
659.	lbs.		No. 6	
665.	lbs.	No. 4		
718.	lbs.			No. 5
777.	lbs.		No. 5	
838.	lbs.	No. 3		
860	lbs.			No. 4
905.	lbs.		No. 4	
1064.	lbs.	No. 2		

Mr. Fowle: The principal object of the paper is to show the comparative advantages of telephone service as compared with telegraph service, and also the advantages of simultaneous use of circuit for telephoning and telegraphing over the same wires at the same time. The principal conclusion brought out is perhaps that shown on page 17, in the middle of the page. The conclusion is that economy in wire use consists in building moderate-haul telephone lines for simultaneous use, arranged to handle the long-haul service by telegraph. The expression used here:

> "When there are special uses for long-haul telephone circuits, they are no more expensive than morse circuits"

refers to the total cost of handling the business. On railroad lines where the traffic of transportation is light or moderate, where one train dispatching circuit and one combined business and commercial circuit cut in at all offices are sufficient, and on single track branch lines where the railroad traffic is light, the

telegraph probably represents the cheapest way of handling the business, because the cost of morse operating there is very slight. The station agent is a morse operator incidentally. He would get the same monthly wages if he was not a telegraph operator. Where the business gets heavier and there is considerable through business from division points to the principal offices, a great deal of that business can be handled economically by telephone, particularly if the telephone lines are composited or symplexed. So that you get morse service out of it as well. The first important thing in the detail is the method of determining cost, on page 3—"what constitutes cost." There are two parts in the cost of owning and operating a system of any sort. The first consists of the fixed charges on the plant, the cost of the plant before it does any work; and second,—the cost of operating the plant,—the wages and incidental expenses. The manner of considering the cost is made clear there.

On page 5 is given a table showing the weight of copper wire required to talk various distances. As a general proposition it is simply a case of spending more money to talk greater distances, and also with a given distance it costs more money as you increase the loudness of the talk. The farther you talk, the larger the wire that will be required. That is pretty clearly shown in the table: In the left-hand column are given the distances in miles, and then in the other three columns on the right are given the weight of one wire in pounds per mile for three different volumes of transmission, that is, for three standards. The first one is 850 miles of metallic circuit of No. 8 B. W. G. copper wire. That is a pretty good transmission, and in fact is louder than is necessary. It is usually for transmission on city service, or local service. You have probably noticed that in a municipality you get very loud transmissions, and sometimes you hold the receiver away from your ear, because if you put it up too close it is annoying; 1,200 miles of No. 8 metallic circuit represents pretty good transmission and for ordinary work that is all right. Perhaps it is not loud enough for cases where you

have a very noisy office, with trains passing or noise from the street, but probably where the majority of the traffic is short-haul it is all right for the small long-haul traffic under ordinary conditions. On very long-haul traffic where transmission is not very loud, it is probably a good scheme to use two telephone receivers. In talking long distances I think it more than doubles the efficiency to have a receiver for each ear. It is a perfectly natural thing, because when one hears anything ordinarily it is heard in both ears. If you talk in the telephone and put a receiver to each ear there is no sense of straining in one ear to get the transmission. One seems immediately to be in ordinary conversation and it removes the idea that one is straining to hear something hundreds of miles away. It is a thing worth while, at a very small cost, when you have long-haul traffic and there is a great deal of it from a few stations.

On page 6 are given some details about cables and the construction of cables, and what is considered the best and the cheapest practice in telephone work.

On page 7 is given a table of cost of paper insulated cable, with twisted pairs, of the various gauges and various number of pairs, enclosed in sheaths. Those are average prices, and probably are fairly correct for the present market prices of lead, copper, tin and labor. The cost of cable varies with the amount of cable ordered. There is a great deal of expense involved in building a cable, and the time expended in setting up the machinery before the cable is made. If you want only a few hundred feet of cable you will have to pay considerably more for it; if you want several miles on one setting up of the cable machinery, you will get it at a great deal less cost per foot. The estimate of cost on page 9 of course is based on average prices, and the comparative cost of copper against iron is based on the 15-year life of iron and 50-year life of copper. There is no definite information about the ultimate life of copper wire. We do know that copper will not last under certain conditions; but under normal conditions, if lines are strung free from smoke

and chemical gases of any sort, the life has not been reached. No doubt iron wire has lasted in some cases more than fifteen years, and there are instances where iron wire has been in service twenty-five years. I think it is a fair comparison to take 15-year life of iron as against a 50-year life of copper wire. A discussion on this might bring out a great deal of difference of opinion, however.

On page 12 a short discussion of open wires versus cable applies more particularly to work in large terminals where there is a private branch exchange and station circuits are at a considerable distance. The intention of this discussion is to show where it becomes economy to make use of cable.

Page 15 contains a suggestion in regard to the use of existing wire facilities. Of course, there are a good many conditions where that cannot be done because it practically means rearranging the whole telegraph line; because there are no wires of the same gauge on adjacent pins which could be used for telephone circuit. There are probably though a good many instances of lines in such shape that this could be done at the present time without any great cost. In any particular case the criterion to determine whether or not it ought to be done is the amount of business which is to be handled and the cost of reconstruction to get telephone use as well as telegraph use. I will now leave the paper open for discussion.

President: Gentlemen, you have all heard the remarks made by Mr. Fowle. Mr. Fowle consented to furnish a paper for the Association members at this meeting, and he certainly has been to a great deal of pains and work to get up this paper. I appreciate it very much. I started to read it over the evening I was leaving home, but turned it over to our general superintendent and said: "There is a lot of ammunition." There is a good deal in this paper and a lot of information, and it takes a little time to digest it.

Mr. Kinsman: I move that a vote of thanks be given Mr. Fowle for his paper. It is a comprehensive paper indeed.

Motion seconded and carried.

President: Mr. Fowle, you receive a vote of thanks from the members of the Association.

Secretary: I hope that some member, Mr. President, will start a little discussion on this very interesting paper of Mr. Fowle's. It is hardly complimentary to a man to prepare a thing of this kind and then have it fall with only a vote of thanks. There are some points there on which perhaps Mr. Fowle can learn something from some of us. I presume he would be very glad to have any information pumped into him if we have it on hand. I was quite struck with the fact myself that iron wire did not last but fifteen years. I have some that is thirty years old, and I do not know how much longer I will have to keep it up.

Mr. Foley: I guess the life of iron wire depends largely upon whether you want to sell it or buy it. I would like to inquire of Mr. Fowle what rental would be charged railroad companies that have the standard agreement with the American Telephone & Telegraph Co. for the additional receiver.

Mr. Fowle: I am not prepared to make a rate on that because it is a matter of a precedent and has not been generally adopted and is not very extensively in use. We use it, and I brought the matter up to make its advantages clear under certain conditions. I think it is a thing to be used on telephones where the user talks great distances frequently. I do not think it would be economy to use an extra receiver where you only talk short distances. We would be very glad to take that question up with Mr. Foley.

Mr. Camp: One thing in regard to the remarks of the Secretary as to there being no discussion on Mr. Fowle's paper. He has covered the ground so thoroughly that he has left no room for discussion in my mind, except as to the life of iron wire, etc. We have had some experience on that ourselves. I came down on

the train with Mr. Fowle and he kept me so busily talking that I have not had a chance to read the paper yet, but as far as I have looked into it I do not see much chance left to discuss it, and, therefore, the more thanks to Mr. Fowle.

Mr. Chenery: I feel a good deal like some others present, that they have not had the time to read this as thoroughly as should be for discussion. I am only sorry Mr. Fowle did not read the paper entire, so we would have it fresh before us. There is, however, one point not quite clear to me. That is the table on page 5. I do not quite get it, and I would like to ask Mr. Fowle to explain just what is meant by that table.

Mr. Fowle: To take a specific example: In the left-hand column take the distance 700 miles. In order to talk as well as you would talk over a No. 8 gauge metallic circuit for 850 miles, you would require a wire that weighs 350 pounds to the mile. In other words, if you had previously talked over such a circuit and decided that 850 miles of No. 8 metallic line gave you loud enough transmission, and then you had a case where you wanted to talk 700 miles and get the same efficiency it would require a wire weighing 350 pounds to the mile or 700 pounds per mile of circuit. For a standard of 1,200 miles No. 8 metallic circuit it would take a wire weighing only 230 pounds per mile, or 460 pounds per mile of circuit; and for an 1,800 miles standard it would take a wire weighing only 135 pounds per mile of wire or 270 pounds per mile of circuit. The last case would furnish rather weak transmission.

Mr. Chenery: I understand it now. That covers the point. I believe I spoke to Mr. Fowle about a circuit that our company was trying to get some service out of. This circuit was 42 miles long. I wanted to get a metallic circuit. I had one wire that terminated at this distance, but the other wire was 345 miles in length. I do not know that this is particularly a parallel case. I just mention it, however; what we were trying to get out of it. We used this long wire to get the other side of the metallic cir-

cuit, both being No. 8 iron. We first tried 6 microfarad condensers, but we found it interfered with the long circuit. We finally cut them down to 2 microfarad and we got very much better results, but not entirely satisfactory. We could not telegraph the entire distance without changing our adjustments. I think talking over this 42 miles iron wire would be equivalent to talking 248 miles of No. 8 B. W. G. copper wire.

Mr. Fowle: I recall Mr. Chenery's case. I think probably there would be difficulty in working over 345 miles iron wire with 43 miles composited and the remainder straight morse circuit, and there might be difficulty in adjusting the morse instruments. The most satisfactory service would be obtained by putting in repeaters at the 43 mile point and working the first 43 miles through the composite, and the remainder of 302 miles as straight morse circuit.

Mr. Chenery: That is what we expect to do, but I wanted first to make this experiment to see if we could use that wire continuously without the repeaters, but I do not think we would get the results that we would with the repeaters.

Mr. Kinsman: Mr. Fowle spoke of conditions under which copper wire would fail inside of perhaps fifteen or ten years. I would be glad to have him elaborate a little on that. We have had copper wire in telegraph service for fifteen or eighteen years. We have never run across any conditions yet where it has seemed to deteriorate at all. I suppose there are conditions, and I would be glad to learn what they are.

Mr. Fowle: The conditions are where lines go alongside of chemical works, where we get gases of a sulphurous nature, or gases coming from the manufacture of sulphuric acid and general chemical operations. The wire has lasted not more than five to ten years in those cases. That is an extreme case and I think it is a rare occurrence, but I only wanted to show that there were conditions where even copper wire would not last.

Mr. Kinsman: Speaking of those sulphur conditions, we get

in Illinois soft coal about as much sulphur as we would get from these manufactories, and I think we have one instance now where we have to renew our iron wires. We did before we took them all out. We had in No. 8 gauge iron wire that would not last more than two years. For instance, in Springfield shops our wires run over where the engines stand. A No. 8 wire would have to be renewed every two years; but over that same line we have strung a copper wire. We strung it in 1887 an we have from time to time cut pieces out of that copper wire over where the engines stand, and they are just as perfect as when they were put up. We have taken all the iron out now.

Mr. Camp: This is also news to me. At Sudbury, where we have very large nickel and copper deposits they have roasting beds for roasting the ore before sending it to the smelting works in the United States. We found that iron wire around that district would last only about three or four years. An ordinary wire fence was put up along the railway, and in three or four years nothing was left but the fence posts. We have put up copper wire now and hope that this will last. Mr. Fowle's remark that it might not last more than fifteen years was a surprise to me. We have copper wire that has been up since 1886 and we find no deterioration there from the fumes of the locomotives.

Mr. Fowle: I think that experience has proved that use of copper wire in the yards or where the line is subject to sulphur smoke from locomotives, is all right. I think that the sulphurous gases are not of an acid nature so that they attack copper wire. I think gases that come from chemical works are of far greater strength and chemical activity than anything found in soft coal smoke.

Mr. Griffith: I have a particular case in my own territory along side of one of these chemical works, where a copper wire would last only about three an one-half years. We finally tried some aluminum wire at the suggestion of the aluminum people, some six or eight years ago. It worked very nicely for about six

months, and one day in the busy part of the day the wire opened. A lineman was sent out to close it. The wire was open opposite the chemical works. I could not find it for three sections. It had evaporated.

Mr. Hewitt: Talk about the deterioration of copper wire, we have at Beaumont and for twenty miles west near the oil fields, copper wire eaten up by the sulphur where it has very badly deteriorated in two years. Aerial cables strung have only been up eighteen months. The copper wire is eaten in two and the 210-pound copper on the line is badly pitted, all the way from Beaumont west. The iron wire is eaten up in about one year, and we now have an estimate in for coppering that circuit from Beaumont twenty miles west. Inside Beaumont we use lead-covered cable. The lead seems to protect it from the sulphur fumes.

President: This is very interesting. We have no chemical plants in our part of the country. Are there some other gentlemen present who have something to say on this matter. As a usual thing where we have wires that are partially eaten up with gases from the engines in yards, we examine them very closely and men have orders to cut out all bad wires in such places. At Sioux City, Iowa, we had one very bad place, where the Illinois Central and our own engines caused a great deal of trouble. We cut them out and put in copper and we have had no more trouble of that kind, but we find it necessary to make close inspection of all such stations where trains stop for coaling.

Mr. Camp: Does that refer both to iron and copper?

President: Iron and copper, but principally the iron wires.

Mr. Kinsman: On the line of Mr. Griffith's remarks about aluminum wire it might be of interest to state that several years ago we had a call for an additional circuit from St. Louis to Detroit, nearly 500 miles. At that time copper was pretty high, I believe worth 22 cents a pound, and I looked into the matter of aluminum, which we could buy at that time for 30 cents a a pound, and we found we could save several thousand dollars

by putting up an aluminum wire and it looked very well. But we thought it advisable to make some tests, although we had some nice letters from people who were using it. We got a number of samples of this aluminum wire and made tests for conductivity and for tensile strength, at the shop laboratory, and they were all very satisfactory, but there was a doubt in my mind about the aluminum wire standing up under weather conditions, and the hard times happening to strike us about that time so that the order for the expense was canceled and we had plenty of time to continue the tests. I took a number of pieces of this aluminum wire and made joints and connected them up, for instance, one piece with iron wire and another piece with copper, knowing that we would have to make these connections at various places along the line. I connected up three or four in this way and threw them into an old barrel of water. I told our foreman to let them lay there a while. I had an idea that the aluminum would go to pieces. We let those wires lay there four months. At the end of four months we took them out and in every case we found the aluminum wire had disintegrated. We found it had grown soft. The copper and iron were all right. Just what the action was I do not know, but as Mr. Griffith said, the aluminum was absolutely worthless.

Secretary Drew: I learned yesterday from a gentleman who had made some similar experiments with aluminum wire, that the great difficulty with it was that even where you made aluminum joints, that the kinking of the wire and where you tied it on to the insulators, would apparently make it so brittle that it would fall of its own weight and break at those places, and that he was satisfied we could never use aluminum for our regular telegraph or telephone circuits.

Mr. Chenery: I assume that while we have Mr. Fowle with us to-day it would be proper to fire at him all kinds of questions with reference to composite and other telephone matters.

President: That is what we have him here for.

Mr. Chenery: I think nearly every gentleman present has something to do with private branch exchanges at different points on their line. For instance, on the line I represent we have a few, and probably will increase them. I have in mind a private branch exchange at Kansas City. It is located distant, we will say in one case 60 miles; in another case 47 miles, and 100 miles to another division point, where it might be of advantage to us if these division offices had telephone connection with our general superintendent located in Kansas City, eventually perhaps with service connecting to our general offices in St. Louis. I have had sort of a dream of connecting up some such system, but that dream has not materialized, as I have not been able to convince our people that it is necessary to expend very much money for it. I have had in mind, however, the getting of a metallic circuit, we will say from this switchboard to the division offices, as I have stated, by using our present iron telegraph wires. Now we have not at present the wires that are direct. That is, without intermediate stations. In some cases within that 60 miles of line there are perhaps eight or ten intermediate telegraph stations. Now I would like to ask if it would be feasible to use two single No. 8 gauge iron wires to get a metallic telephone circuit and bridge them around these intermediate telegraph instruments?

Mr. Fowle: I would like to ask if there are eight or ten offices on both of those wires or only on one of them?

Mr. Chenery: Practically the same number of each circuit.

Mr. Fowle: Do you want to get telegraph service over each wire to each point? You want to get a composite out of that metallic circuit?

Mr. Chenery: Yes, sir.

Mr. Fowle: I think that represents a condition pretty hard to meet, because with eight intermediate offices it would mean ten offices including the terminals, and that would mean twenty sets of composite, and I do not think you would get any satis-

factory telephone or telegraph service through that. The best results you could get out of that would be to use your two No. 8 gauge iron wires for metallic circuit, and symplex that. Then you could handle your morse circuit better. If the use of the telephone by putting intermediate telephone stations on that line, there being not too much through business, you would relieve your present morse business so that one morse line would handle the business of the two morse lines that now exist.

Mr. Chenery: To get the same results, then, we would have to have one additional wire, as I understand it. The two iron wires I speak of are crowded now to their limit. It would be necessary to put up an additional wire.

Mr. Fowle: It would be necessary to do that if you want to keep your two telegraph circuits cut into all offices.

President: I would like to ask if you get that new wire would it not answer the purpose? Also if a single wire 60 or 80 miles between the general superintendent's office and the division points could not be cut into the general offices so that different wires could be switched on to that iron wire?

Mr. Fowle: Do you mean grounded iron wire?

President: Yes, sir.

Mr. Fowle: It is considerably less efficient. You will find the line there very noisy, and you have got to have considerably louder transmission to get over that noise, and an iron wire will not always furnish it. If you have one iron wire and make that a metallic circuit and symplex it, and take eight intermediate stations on the symplex, I think you would get good results.

President: It would be necessary to transpose that?

Mr. Fowle: Yes, practically every half mile. On the L. S. & M. S. the circuit is transposed every half mile, being transposed opposite the mile posts and then half way between. On the pole line is a circuit from New York to Chicago, on which is worked a Wheatstone transmitter. That circuit was originally

adjacent to the telephone circuit, removed only one or two pins, and at night there was no trouble when the Wheatstone was not working. In the day time it was necessary to transfer the Wheatstone to another wire, getting it as far away from the telephone circuit as possible, and I understand that since that has been done the service is very satisfactory, so that transpositions every half mile are good enough. For lines on which there are adjacent morse duplex and quadruplex circuits you have probably got to transpose every quarter mile or else get your duplexes and quads six to eight feet away from the telephone circuit.

President: Mr. Fowle, what is a fellow going to do if he has a wire already strung among twenty-four other wires? I have a short wire between two offices and can cut it out of the offices and use it for telephone service in connection with one of the other wires, but cannot very well transpose it.

Mr. Fowle: I think you are up against it, unless you can prove that the cost of rearranging your line, or making any substitution or changes, will be worth the cost.

Mr. Chenery: May I ask, Mr. Fowle, in speaking about getting the single circuit in the switchboard. I understand that a grounded circuit will not operate successfully in a common battery switchboard.

Mr. Fowle: There may have been conditions under which that statement was perfectly proper. I think generally it is physically possible to work any kind of a grounded trunk line into a switchboard, irrespective of whether it is common battery or magneto. In the common battery system the method of supplying battery to the transmitters is from the central office, over the wires used to talk on, from a single or common battery for all transmitters. In a broad sense it is really a composite system, and the central office battery, for reasons of operating, is grounded, and that ground introduces additional sensitiveness to inductive disturbances. If you bring your grounded wire into

a private branch exchange through a repeating coil, I think you will be free from any trouble.

President: One of my schemes was to get a metallic circuit from the Telephone Co.'s office in the main part of the city out to the outer part of the city, a mile or a mile and a half, and then connect it for a circuit of 85 miles and use one of the through wires in order to make a metallic circuit, and one private wire for the single wire for the telephone.

Mr. Fowle: You intend to use a metallic circuit on your own right of way and want to use the telephone company's wires to get into the city. That is entirely feasible. You have a straight or uncomposited circuit to where you meet your right of way, and then take it to your nearest office and there symplex it and connect to your straight morse wire for your own right of way, then for your 85 miles you have a symplex telephone circuit.

President: Can I connect that with the switchboard?

Mr. Fowle: Is it metallic all the way?

President: Yes, sir.

Mr. Fowle: Then you can connect it.

President: I was figuring on what we could do, putting in a composite circuit, using one wire—I can single that straight all the way through for 85 miles, for telephone purposes. I have several through wires that are longer distances. I thought I might use one set and one of those wires in order to make a metallic circuit, and then get a lead from the telephone company out of the general office in the central part of the city to the outskirts of the city for a distance of a mile and a half, a metallic circuit from the telephone underground, and that would avoid our getting through our cables underground. Then we would have clear wires on telephone poles for a distance of 85 miles. Now I would like to cut into the general superintendent's office, the car service department, division superintendents' offices, etc., with this 85-mile wire.

Mr. Chenery: You have the same proposition I first spoke of.

President: I was figuring on that and then I wanted to know if I could work this single wire single.

Mr. Chenery: In intermediate offices?

President: No.

Mr. Chenery: There is no reason why you could not work that in with the central repeaters. Mr. Fowle spoke of a symplex circuit. You are not getting that.

Mr. Fowle: You want to take two existing telegraph circuits and make a single circuit clear of offices?

President: Four test offices.

Mr. Fowle: That is entirely feasible, I think. If you have no intermediate offices for your 85 miles you can make a metallic telephone circuit and composite each side of it. Then you bring it into within a mile and a half of the city and there you have a composite set, so as to diverge to the more efficient telephone cable, and avoid bad conditions at your terminal.

Mr. Camp: Would it be necessary to transpose those wires every half mile?

Mr. Fowle: Yes, sir.

President: That cannot be done.

Mr. Groce: I would like to ask Mr. Fowle what kind of connection he would make with this metallic circuit at the city limits. Whether he would have to introduce some kind of choke coil?

Mr. Fowle: The composite apparatus contains the choke coil.

Mr. Drew: I would like to ask Mr. Francis if that is not almost exactly the situation of the C. M. & St. P. Ry. between Chicago and Milwaukee?

Mr. Francis: They have not got that line working. They have been experimenting with it.

Mr. Drew: I understood the experiments were very satisfactory. That they obtained the use of the telephone company's lines out of Chicago as far as Western Avenue, and in Milwaukee out through the cables under the different branches of the river until they struck a clear line on their own right of way, and that that worked very satisfactorily, and I understood they were going to have it permanently installed.

Mr. Francis: They can talk on it all right, but have not been able to get the ringing as they want it. That is one of the features they have been working on.

Mr. Chenery: May I ask, Mr. Fowle, if there are not two systems or two estimates for the composites? That is the grounded composite and that known as the metallic composite, and if you could use the grounded composite on the metallic line?

Mr. Fowle: The grounded composite that we use is adapted from the metallic composite which we employed a long time before we arranged for the grounded composite. That is, the grounded composite is a part of the equipment of the complete metallic composite. The question of bringing circuits into telephones over telegraph companies' lines brings up the question of cables, and that, it seems to me, is very important. I think that in new construction and in all new work you will find if you compare the cost of cables similar to those you are now using in many instances, with the cost of cables on which quotations are made for paper insulation, twisted pairs and enclosed in lead sheaths, that you will come out with the greatest efficiency for the least money when you use the standard telephone cable, and if you have twisted pairs in those cables you will not be in any way obliged to use them as twisted pairs. They are used as single conductors with just as much efficiency. Then if you

employ such cables you are always prepared for composite or symplex service—anything that may come up.

Mr. Campbell: With reference to using twisted pairs in telegraph cable, I think it would be hardly as feasible to do that as for telephone service, for the reason that we use a much heavier conductor. Our insulation is much heavier, and by the time you twist your pairs your cable gets pretty bulky.

Mr. Fowle: As the size of the conductor increases in the cable the thickness of insulation increases also, and therefore the larger the gauge of the cable the more potential it will stand because of the thickness of insulation. The cables that we use of No. 13 Browne & Sharpe gauge are tested for insulation with a potential of one thousand volts.

Mr. Griffith: In line with Mr. Fowle's suggestion of combination cables so to speak, of cables carrying both telegraph and telephone circuits, I am pleased to report that the Erie has them in operation and finds them very satisfactory. The insulation, however, is a little bit different from that which Mr. Fowle describes. We first have the dry paper on the bare conductor. Then we have rubber insulation over that paper. The wires are twisted in pairs. In the particular cable that I refer to we have 19 pairs, and over all we have the lead sheath, and it is working very satisfactorily as a telephone and a telegraph cable. Seventeen of those pairs are working in connection with our private branch, and we have no noise whatever.

Mr. Fowle: I would like to say that that is undoubtedly a very satisfactory cable. The point that appeals to me is where the economy comes in in using the rubber. I suppose the answer is that it gives additional insulation over the paper. In my paper on page 6 I mention an arrangement of that sort:

"Cables have been proposed with conductors insulated with rubber and then wrapped with paper; the advantages of this consist only in the advantages of rubber as an insulator, for the capacity will be practically that of conductors with insulation

wholly of rubber. Cables have been proposed with the above arrangement reversed—the paper being applied first and then covered with rubber; such a cable will be more expensive than a paper cable, for a given efficiency. The capacity will be intermediate between that of a rubber cable and that of a paper cable. One of the advantages of the paper cable is that it may be laid up loosely, thus admitting air in the loose wrappings of paper and making the capacity even lower than a tightly laid up paper cable. It will be difficult to apply rubber insulation over the paper without compressing it and excluding the air."

The whole point as to the straight paper cable compared with the cable last described, is the fact that the capacity will be a little greater, and consequently to get the same efficiency it will take a little more copper in the cable; a little larger gauge of wire with the paper and rubber insulation for the same total efficiency. Consequently it will cost a little more money for the same efficiency. I will say that where the conditions are especially bad, there may be some consideration as to whether a cable insulated entirely of rubber should not be used on account of mechanical conditions. But for long stretches where there is considerable cost involved I think it would be economy to use paper cable and put it up in a substantial way to prevent it as much as possible from injury.

President: Gentlemen, any further discussion on this paper of Mr. Fowle's?

Mr. Fowle: I would like to offer the suggestion that perhaps the paper has not been read by everyone. There are some things here from a traffic standpoint rather than from a physical standpoint that some of the members might like to discuss to-morrow, after reading it over. There is likely to be difference of opinion on that subject under different conditions. I believe considerable might be brought out by a discussion.

President: There will no doubt be other members arriving this afternoon and evening and I think it would be better to

leave this open so as to bring it up again to-morrow, and give the members an opportunity to read the paper over and become better acquainted with it and discuss the matter between themselves

Secretary: Mr. Chairman, it is now 12 o'clock, and if it is agreeable I move that we adjourn to meet promptly at 10 o'clock to-morrow morning.

Motion seconded.

President: I will say for the benefit of the members and friends just arrived, that we have had a very delightful meeting this forenoon. The Mayor has welcomed us to the city and we have heard Mr. Fowle's paper read and partially discussed, and will re-open it again to-morrow morning for discussion. The motion now before the house is to adjourn until to-morrow morning at 10 o'clock. All in favor please say aye.

The meeting is adjourned.

SECOND DAY.

May 18, 1905, 10 a. m.

President: Gentlemen, I believe we are all ready to call this meeting to order. Mr. Secretary?

Secretary: I have some telegrams to read:

From Chicago.

"I acknowledge with great satisfaction your telegram announcing my election as an honorary member of the Association of Railway Telegraph Superintendents. I have never had occupation in life that excelled the pleasure of my early association with telegraph interests. (Signed) Marvin Hughitt."

From Minneapolis.

"I desire to express my cordial appreciation of the honor conferred upon me. Trust you will have a most pleasant and beneficial meeting. (Signed) T. P. Cook."

From New York.

"Your message received. I appreciate very highly my election as an honorary member of your association. Please convey to the convention my most hearty thanks, also best wishes to each and all of you. (Signed) B. Brooks, Gen. Supt."

From Toronto

"Please convey to the officers and members of the Railway Telegraph Supts. Assn. my appreciation of the honor they have conferred on me, and I hope that they will have an interesting and enjoyable meeting. (Signed) James Kent."

From New York.

"I thank you sincerely for your telegram informing me of my election as honorary member of your association. I can assure you that I appreciate the honor. Please remember me kindly to all of my friends. (Signed) R. C. Clowry."

"Telegram received. I appreciate most highly the distinction conferred upon me by the Railway Telegraph Superintendents' Association by electing me an honorary member of that organization. I hope you are having successful meeting and regret that I am not with you. (Signed) J. C. Barclay."

I will read the names of those who have sent in their regrets, not being able to be with us:

C. S. Rhoads; E. J. Little, of the Great Northern, from Vancouver; he was the chairman of our Committee on Topics; also one from G. W. Dailey, of the C. & N. W., Chicago; one from J. E. Gordon, our associate member who is now located at Albany, N. Y., with the Hudson River Telephone Company; one from M. J. Maiden from Indianapolis, whom we all remember so well at the meeting there; also one from L. G. Richardson; one from N. E. Smith, of the N. Y., N. H. & H. R. R., trusting we will have a pleasant meeting and sorry he cannot be present; and one from Jno. Brant, who is detained by illness.

Mr. Levin: Mr. President, I desire to express my thanks to

the members for the honor conferred by electing me an honorary member of your association.

Secretary: We have a telegram that came in yesterday which rather surprised us a little. In the first place we had invitations from Atlantic City, Niagara Falls, Columbus, Ohio, and St. Louis, Mo., to hold the meeting at those places. These were probably from those who were connected with boards of trade, hotels, etc., but yesterday we received this telegram, which I will read:

Denver, Colo., May 17, 1905.

P. W. Drew, Secretary,
Association Railway Telegraph Superintendents,
Chattanooga, Tenn.

The undersigned representatives of telegraph and telephone interest of Colorado respectfully submit the city of Denver as the place for holding your next convention.

Chas. J. Parker,
W. C. Black,
E. E. Duncan,
E. M. Burges,
K. M. Walker,
J. J. Burns,
A. A. Gargan,
Jos. Munday.

Secretary: If it is in order, Mr. President, I suggest that we at this time act on these invitations and decide where we will hold our next meeting.

President: Gentlemen, you have heard the invitations that have been presented here to us, several good places. I would like to hear an expression from some of the members in regard to their choice for selection of the next meeting place.

Mr. Kinsman: I move you, Mr. Chairman, the next meeting of the Association be held in Denver, the third Wednesday in June, 1906.

Motion seconded by Mr. Griffith.

President: Are there any other suggestions? If not, gentlemen, you have heard the motion made by Mr. Kinsman, seconded by Mr. Griffith, that our next annual meeting be held the third Wednesday in June, 1906, in Denver, Colo. All in favor say aye, contrary no. Carried. The next meeting will be held the third Wednesday in June at Denver, Colo. I believe the Secretary ought to notify those gentlemen that we have accepted their invitation.

Secretary: I will wire them.

President: I would like to say that the Mayor of Indianapolis, through a letter to Superintendent Rhoads, regrets very much that he could not be present at our meeting on account of the objections that his wife, Mrs. Holtzman, offers, that Mr. Lang offered such great inducements of the pretty ladies and so on at Chattanooga, he declined to leave, and he wanted us to notify Col. Lang to that effect. Otherwise he would have been here.

Mr. Lang: I suppose that objection will be removed at Denver.

Secretary: There are two papers reported, Mr. President, and Mr. Selden will also have a report from his committee, but he will not be in for an hour or so. We have a paper from Mr. Camp and one from Mr. Maver that we ought to have this morning.

President: Mr. H. Raynar Wilson, from England, is in the city. I do not know how much of a telegraph man Mr. Wilson is. He at one time was secretary of what I understand to be a commission something like our Railway Interstate Commerce Commission, and is a very bright man. He is high up on signals. I do not know what he knows about telegraphing. He promises to address the members. Mr. Wilson will be present some time to-day.

Secretary: I would suggest that we have Mr. Camp's paper, then.

President: Mr. Camp, will you give us your paper? I suggest that you come up in front and face the audience.

Mr. Camp: Mr. President, I will say first that the paper is meagerly written up, and not put in very good shape. I am not a writer, and I had not time to properly compile it, and since I wrote the paper out I have received some further information on the subject:

HIGH TENSION WIRES ON RAILWAY RIGHT OF WAY.

(This includes also the crossing over the right of way on telegraph lines.)

By W. J. Camp,

Electrical Engineer, Canadian Pacific Railroad.

Installations are being made at various points throughout the continent for generating electrical power and transmitting it to a distance; the voltage on the transmission wires varying from 10,000 to 70,000 volts, according to the conditions.

Applications have been made to the different railway companies for the privilege of carrying the transmission line along the railway right of way, and it is altogether likely that the number of these applications will increase.

The main object of this paper is to bring the subject before the Association for discussion, as the writer has very little data.

The Telegraph Department of the Canadian Pacific Railway has generally opposed granting permission for various reasons, such as danger to life and property, induction on telephone lines, etc. Up to the present the working of the telegraph wires of the Canadian Pacific Railway have not been affected, although there are several power lines paralleling the line, for instance, in British Columbia, 20,000 volts from Nelson to the power house 16 miles; from the power house to Rossland 55 miles, two power

circuits parallel the railway for 20 miles, then diverge for some distance, when they again parallel for 15 miles. The distance from the telegraph wires varies from 30 to 200 feet. On other sections in Eastern Canada, power lines are on the right of way, in one case for 10 miles, but on the opposite side of the track from the telegraph line.

I am informed that the Great Northwestern Telegraph Company has suffered somewhat from induction on a line between Chambly and St. Lambert, 20 miles, and between Shawinigan and Montreal, 95 miles. In the latter case the power line is on the opposite side of the track from Shawinigan to Joliette, 59 miles; from Joliette to L'Epiphanie, 12 miles, it takes a different route; from L'Epiphanie to Charlemagne, 10 miles, it is close to the telegraph line. No ill effects were experienced on the telegraph wires until they were transferred to the present route from Joliette to Montreal (new piece of railway), but since then it has been found very difficult to keep properly adjusted on account of a continual hum from the power circuit. The voltage of the power circuit is about 50,000.

It might be well to introduce here the subject of foreign wires crossing the railway right of way.

In Canada there is a Railway Commission consisting of three persons who are appointed by the Governor General in Council. All matters concerning the construction and operation of railways must be brought before this commission. The Railway Act 1903 amends and consolidates the law respecting railways and includes the duties and scope of the Railway Commission. Section 194 reads as follows:

"No lines or wires for telegraphs, telephones, or the conveyance of light, heat, power or electricity, shall be erected, placed or maintained across the railway without leave of the Board.

2. Upon any application for such leave, the applicant shall submit to the Board a plan and profile of the part of the railway proposed to be affected showing the proposed location of

such lines and wires and the works contemplated in connection therewith; and the Board may grant such application and may order by whom, how, when, and on what terms and conditions, and under what supervision, such work shall be executed; and upon such order being made such lines and wires may be erected, placed and maintained across the railway subject to and in accordance with such order."

The usual procedure is for the company desiring to cross, to make application to the railway company, and after the two companies have reached an understanding, it is submitted to the Railway Commission.

We have tried various devices for protection from high tension wires crossing the right of way, generally using something in the form of a cradle, the latest device being shown in the attached blue-print. This has been adopted as our standard.

An article appeared in the Electrical World, May 21, 1904, recommending the use of high poles and short span, so that if the high tension wires broke, neither end would be long enough to reach either the track or telegraph line. We have a crossing arranged on this principle in British Columbia. The power wires are 400 feet above the track; parallel with the track on each side, a heavy iron rod is supported on poles and earthed. Generally this plan is impracticable. The article also mentions a wire screen over the telegraph wires, but no protection for the railway.

Another article appeared in the Electrical World May 21, 1904, giving a somewhat similar arrangement, but using iron pins and arms which are earthed; and also a grounded cradle device.

The Transactions of the American Institute of Electrical Engineers for September, 1904, contains a committee report on high tension transmission which includes a list of protection devices for crossing other wires, highways and railways. From the discussion of the report it appears that the system of using a

screen under the power wires was the one most in use, but many objections were raised, although nothing better was suggested.

In conclusion I would ask: Should high tension lines be kept off the railway right of way, and why? Also, what is the best device for protection where high tension currents cross the railway, and should the same be used for telephone and other wires also?

Since writing the above I received the following advice from our superintendent in British Columbia referring to the line between Nelson and Rossland:

"No appreciable induction excepting when power wires partially grounded between stations, then quite bad, even when location of ground is two or three miles away and across the river."

I also find that the Postal Company experience a similar effect in the neighborhood of Detroit.

I have managed to secure a copy of the proceedings of the meeting of the American Electrical Engineers—but before that I might give a description of the cradle which we have adopted as our standard:

The cradle protection which we have adopted consists of the arms on the power line poles on each side of the track being made longer than usual, with an extra arm above the wires carrying the high tension current. From the end of each of these arms I have $\frac{5}{8}$-inch galvanized stranded steel cable stretched to the opposite side, and also from a point below the cross arms. These wires are then connected together with cross wires down to the ground, and then up on the other side. Also $\frac{5}{8}$-inch galvanized stranded steel cable used as a stay. The whole cradle is then connected with $\frac{1}{2}$-inch stranded steel cable on each pole to the earth, the end in earth—charcoal or coke, and a lot of wire coiled up. The minimum height of the lowest power wire or high tension wire must not be less than forty feet above the top of the rail, or ten feet above the highest telegraph wire. The

object of the device being that should there be any breakage of any of the power lines, it is bound to be earthed through the heavy leads, which are supposed to have sufficient capacity to carry any current that may leak from the high tension wires.

I brought the published proceedings of the Electrical Engineers' meeting, in case anyone should want any information they could pick out of it, but it is quite a long report and I hardly think we have time to read it through unless it is desired.

President: Gentlemen, you have all heard the paper as read by Mr. Camp. It is a splendid paper. I notice the Canadian law provides:

"No lines or wires for telegraphs, telephones, or the conveyance of light, heat, power or electricity, shall be erected, placed or maintained across the railway without leave of the Board."

I wish we had a law of that kind in the five states through which our system runs. It would help us out a great deal. Gentlemen, this paper is up for discussion. I would like to hear from some of the members. I would like to ask if any of the members have a law in their states similar to the Canadian law, whereby the Railway Commission or some other powers are authorized to arbitrate or settle or define the crossing?

Mr. Kinsman: The state of Michigan has a most excellent law, whereby application must be made to the Commissioner of Railroads before any crossing of any kind is made over a railroad, and before that crossing is made a permit must be issued by the Commissioner. The custom usually is that the telephone or the light companies make application to the railroads which they desire to cross, asking them to waive a hearing before the Commissioner, and if satisfactory arrangements are made this is usually done. The law is a very good one and works very satisfactorily.

Secretary: For the benefit of the members who have joined since that time, I wish to say that in the back of the minutes for

1902 you will find the reports from the various states with whom we corresponded about their laws on this matter; from the various Commissioners of Railroads of Michigan, Ohio and Missouri. If any of you desire a copy of the minutes for 1902 and will write me I will be glad to furnish you with same.

Mr. Chenery: The State of Kansas passed a law in reference to this matter on the 26th of April last, a copy of which has been furnished me by Mr. Kaiser, and if it will be of interest, I will read it. It is not very long.

President: We ought to have it.

Mr. Chenery: It bears on this subject, and I believe everyone interested would like to see such a law passed in their own state. If they had such a law it would not be necessary to attempt to secure contracts. It reads as follows:

"An Act to Regulate the Stringing of Wires, Electric or Otherwise, Which Cross Over or Under Railroad Tracks, and Relative to the Support, Maintenance, Repairing and Construction Thereof.

In all cases where any telegraph, telephone, electric light or other wires shall cross the tracks of any steam railroad company, the crossing shall be made in accordance with the following rules:

Equipment.

Section 1. All poles sustaining wires which cross railroad tracks shall be of sound timber, cedar or better, with not less than six-inch tops, and placed in the ground to a depth of not less than twenty-five (25) feet above the top of the rails after allowing for sag, well tamped, braced and guyed if necessary.

The cross-arms shall be braced with iron braces and locust, hedge or steel pins shall be used.

Pin guards shall be attached to the ends of all cross-arms.

Location of Poles.

Sec. 2. All poles carrying wires which cross railroad tracks shall be located not more than fifty-two (52) feet nor less than

ten (10) feet from the track. All telephone and telegraph wires shall cross the track at right angles when practicable.

Height of Wires and Distance from Railroad Company's Wires.

Sec. 3. Such telegraph or telephone wires shall in all cases be twenty-five (25) feet or more above the top of the rails of the track, and shall clear the wires of the railroad or telegraph company on said right of way by at least two feet; provided, that the owners of such telegraph or telephone wires shall in no case be compelled to string their wires higher than twenty-eight (28) feet above the top of the rails of the track; and further, that in case the wires of the railroad company are higher than twenty-seven (27) feet above the top of the rails of the track, such telegraph or telephone wires may be strung under the wires of such railroad company, but not lower than twenty-five (25) feet from the top of the rails of the track.

Change of Lines or Construction of New Lines by Railroad Company.

Sec. 4. In all cases where any telegraph or telephone line has been constructed across any railroad track upon a public highway, the railroad company, in case it may desire to change its lines of wire already constructed or construct new lines, shall clear such telegraph or telephone wires by not less than two (2) feet; provided, that its lines need not be higher than twenty-eight (28) feet above the top of the rails of the track; and provided further, that in case such telegraph or telephone wires are higher than twenty-seven (27) feet, the wires of the railroad company so changed or newly constructed may be strung under such telegraph or telephone wires.

Crossing Under Railroad Tracks.

Sec. 5. In all cases where any telegraph or telephone company shall desire to place its wires under the tracks of any railroad company, it shall, at least five days before so doing, serve a written notice upon the agent of the railroad company at the station nearest to the place where such crossing is to be made.

The wires, cables or conduits used in such crossings shall be placed at least three (3) feet below the bottom of the rails of the track. Excavations for such underground crossings shall in no case be left open for a longer period than twelve (12) hours.

Trolley Lines.

Sec. 6. The foregoing rules shall not apply to the feed or trolley wires of an electric railway, but such wires shall be placed at least twenty-two (22) feet above the tops of the rails of any railway crossed thereby. They shall be carried on or supported from sound cedar trolley poles with not less than seven-inch tops, or suitable iron trolley poles of sufficient height and strength.

Poles, Braces and Fastenings to Be Kept in Good Condition.

Sec. 7. It shall be the duty of the wire-using companies so placing wires above and over the tracks of any railroad company and of any railroad company crossing the line of any wire-using company, to maintain their crossing poles, wires, cross-arms, braces, pins and other appliances in first-class condition at all times.

In Special Cases Application May Be Made to the Board.

Sec. 8. In special cases, where compliance with the above and foregoing rules would work a hardship upon any company in extending its wires over or under any railroad, or of any railroad company extending its wires across the line of any wire-using company, application may be made to the Board to make such order for crossing as said Board shall deem to be reasonable and just.

The above and foregoing rules and regulations shall be in full force and effect from and after this date as to all new construction, and all companies are required to change old constructions at crossings so as to comply with the foregoing rules within ninety days from this date.

Dated at the office of the Board of Railroad Commissioners, in Topeka, Kan., this 26th day of April, A. D. 1905.

President: The entire northwest is being covered with a net work of telephone wires. We have a large number of highway crossings, and as a usual thing the first notice we get is from the line men, or from a section man, that a crew is going to string a wire, what will we do. And I must confess a great many of these farmers' lines and other new companies are getting very shrewd. They have one bright man with them anyway, doing the work, and he will wire you right away that you do not own heaven and earth, and he will get just outside our right of way, and in some cases will not erect double cross-arms and double pins. We do the best we can by getting after them, but it is a nuisance. We urge the necessity or possibility of damages against their own companies, and I have them all pretty well straightened out now, but as I say, the whole northwest is a perfect net work of wires. I presume you all have trouble of this kind.

Mr. Chenery: Would it not be in order for this Association as a body to recommend that such legislation as passed in Kansas, Michigan or Ohio, be recommended for all states, and that it would be in order for the representatives of the different lines to take up with their legal departments the matter of securing such legislation? I think we ought to put that before them.

Mr. Kaiser: Being located at Kansas City, with the Missouri & Kansas Company, I had the pleasure of going before the Railroad Commission of Kansas before these rules were put in force. The bringing about of this law in the state of Kansas was through the Union Pacific Railroad. It seems that a so-called "farmer line" crossed their railroad tracks at a public way, which the farmer claimed he had a right to do, but did not put the wire up on a standard 35-ft. 6-inch top pole. He got a little piece of 4x4 scantling and spiked it together and put a bracket on there, and the result was that the wire sagged and caught the brakeman and of course the railroad company was sued, and no redress from the farmer line company. That was the reason for this law. Now they put this law in force and ask that all companies

or individuals will clear wires on public highways by 25 feet, and insist upon their using 35-ft. poles, and there is a penalty of $100 to the individual or corporation that fails to have the wires of required height within ninety days. At that meeting we had Mr. Jennings of the Rock Island and the legal department of the Union Pacific, and I believe we had one or two representatives of the Santa Fe, and they all agreed to this rule. They found that the greater trouble received was through the small individual who strung a wire across on 4x4 scantling, or anything else he could get, and you will notice in those rules that if they cannot furnish a 35-ft. pole (it costs about $12 in Kansas) that they have the right to cross under the track. The railroad companies even went further by saying that they would be satisfied in the state of Kansas to make that rule apply to a private right of way. They got around the double cross-arms by using what is known as a pin guard. The standard form of pin guard adopted was that, take it on a pole with two arms, it was necessary to bring a piece of No. 10 wire down around the lower arm and up over the top or ridge of the pole to the opposite side, and fastened underneath the bottom arm, so that it was utterly impossible for a wire to break loose from the insulator—to become unfastened and swing over and drag down so as to come within the 25-ft. above the top of the rail.

Mr. Griffith: I think it is about time that this Association should take up the question of high tension currents on all its railroads, and the matter of public safety, and if a committee was appointed by this Association to bring the matter before the American Railway Association, it would have influence in all states, and the duty of that committee be to show and prove to the American Railway Association that such wires are a hazard to the traveling public. I move that such a committee be appointed to confer with that Association and ask them to take it up with the various states. I think they would have more power than we would if we took it up individually with our states, as a general thing.

Mr. Selden: I suggest that if action of that kind is to be taken, the same committee take up the subject Mr. Chenery brought up. In a number of the states there is no railroad commission, but I presume a law could be arranged for railroad crossings even in such instances, and if this committee would bring up at the same time the question that Mr. Griffith mentions, they could with one bite of the cherry, make a good move in both directions.

Mr. Griffith: I accept the amendment.

President: I believe we could make good use of a committee of that kind to take up the question of high tension wires and telephone crossings—all wire crossings. Is that what you intended to cover, Mr. Griffith? Does that motion meet with a second?

Mr. Kinsman: I second the motion.

President: Moved and seconded, gentlemen, that a committee be appointed to take up with the American Railway Association the matter of having state laws made to cover the protection of people at highway crossings of all high and low tension wires, including electric light and telephone. All in favor of that motion say aye, contrary no.

Motion is carried.

I will appoint on that committee Mr. Griffith, as chairman, Mr. Foley and Mr. Adams. They are all eastern gentlemen, where the meetings of the American Railway Association are usually held.

Are there any further remarks on the paper read by Mr. Camp?

Mr. Maver: I will say for the information of the members, in regard to the paper read before the Association of Electrical Engineers at their annual convention in 1904, that members sufficiently interested in that matter can obtain copies of that report by writing to Mr. R. W. Pope, Secretary, American Institute of

Electrical Engineers, 95 Liberty Street, New York, and remitting 50 cents. This seems to be a very important matter and one which it would be well to bring out a little more. Mr. Miller I think has had some experience with that.

Mr. Miller: The question of interference between high tension circuits and telegraph wires has come to the front recently, and we find it a very serious matter. They have made some changes in their style of currents. I cannot explain just what they are. I have not investigated it thoroughly, but between Indianapolis and Rushville, 35 miles, they have constructed an electric line that is operated on the alternating plan. The induction is so great that we cannot work copper wires on that route by Wheatstone, either quadruplex or tickers. We strung a wire to Indianapolis particularly for ticker service, and the interference is so serious we cannot use it. You can place a box relay on the copper wire circuit in my office, and it will roar all around the building. Now just how to overcome that is a problem that has not been solved so far as I know. Of course, it is possible, but the possible ways are very expensive. If we can find some new way to protect the telegraph wires against these induced currents that will not be prohibitive in the way of expense, that is what we would like to find out. I have a good many lines in my district that are paralleled for fifteen and twenty miles by electric lines, some of them on the main highway, but I never had any serious trouble until this case between Indianapolis and Rushville. They are extending that line to Hamilton, so that there will be 95 miles of electric lines parallel to the railroad. These two systems of wires are 33 feet apart, yet we get the induction so seriously that we cannot overcome it. The interference is serious. Does anyone know how to overcome that trouble with reasonable expense? If so, I would like to find out what it is. We have made some experiments to determine just where this induction comes from. They have what I believe they call "converter stations" every ten miles. They have a metallic loop running from their power house to each one of

these converter rooms—sub-stations they call them. In one place, from Rushville out ten miles, there were six loops. We cut the copper wire into the power house; then we opened these sub-station loops to see where the induction was coming from. We found it did not come from them at all. We got our induction right from the trolley. Everything else being thrown open, the induction was there just the same. How to get rid of it is a problem.

Mr. Camp: Does the trolley line use an alternating current?

Mr. Fowle: That railroad Mr. Miller refers to is from Indianapolis to Cincinnati and is operated by the single phase trolley system. It is usually 2,200 or 3,300 volts at about twenty or twenty-five cycles, and the reason that that system is coming in seems to be the fact that the sub-stations are cheaper, and there is no labor at the sub-stations, and there is considerable saving in the cost of feeders for the trolley system. The single phase system usually involves more car equipment and consequently is more expensive in that respect. The same motors on the cars have to move, as a rule, on both alternating current and direct current, because when they go on to city lines they work on 500 or 600 volts direct current. The single phase system shows the greatest economy in long lines of 15 or 20 to 50 or 100 miles, on single track railroads where the railroad traffic is not excessive and there are not a great many cars, so that the increased cost of car equipment does not materially eat into the saving on labor and sub-station equipments. On heavy trunk lines I do not think the single phase railway system will show any great saving. For that reason, while the single phase system will be used to a certain extent, it will not be of universal application, and it need not be feared that the thing is going to be very extensive. The cost of getting rid of that induction trouble is a serious problem of itself. I do not think anyone knows of any very cheap way, at present, to do this. Putting the telegraph line in cable is almost entirely prohibited—certainly so from the standpoint of ticker

service. And as to screens—they will be effective to a certain extent—but it is still an expensive proposition. Apparently there is no way to transpose the trolley line because the rails and ground form one side of the circuit and the trolley line forms the other. Perhaps, theoretically, it might be operated in sections, so that the effect on one trolley section of ten miles would offset the next section of ten miles, but I think the interferences would never counterbalance each other, because the loads and the power factors on two consecutive sections would never be alike.

In connection with the matter of high tension crossing I think it might be interesting to read some extracts from the "National Electrical Code." That is, the rules and requirements of the National Board of Fire Underwriters. Under Class B, Rule 12A applies to constant-potential pole lines, over 5,000 volts:

"a. Every reasonable precaution must be taken in arranging routes so as to avoid exposure to contacts with other electric circuits. On existing lines, where there is a liability to contact, the route should be changed by mutual agreement between the parties in interest wherever possible.

"b. Such lines should not approach other pole lines nearer than a distance equal to the height of the taller pole line, and such lines should not be on the same poles with other wires, except that signaling wires used by the Company operating the high-pressure system, and which do not enter property other than that owned or occupied by such company, may be carried over the same poles."

That applies to a telephone circuit operated by a street railway system or electric road, on a high tension pole line.

"c. Where such lines must necessarily be carried nearer to other pole lines than is specified in Section b above, or where they must necessarily be carried on the same poles with other wires, extra precautions to reduce the liability of a breakdown to

a minimum must be taken, such as the use of wires of ample mechanical strength, widely-spaced cross-arms, short spans, double or extra heavy cross-arms, extra heavy pins, insulators and poles thoroughly supported. If carried on the same poles with other wires, the high-pressure wires must be carried at least three feet above the other wires.

"d. Where such lines cross other lines, the poles of both lines must be of heavy and substantial construction.

Whenever it is feasible, end-insulator guards should be placed on the cross-arms of the upper line. If the high-pressure wires cross below the other lines, the wires of the upper line should be dead-ended at each end of the span to double-grooved, or to standard transposition insulators, and the line completed by loops."

The reason for that, I think, is the fact that a break in some span or the crossing might allow wires to sag or fall through where they could come together.

"One of the following forms of construction must then be adopted:

"1. The height and length of the cross-over span may be made such that he shortest distance between the lower cross-arms of the upper line and any wire of the lower line will be greater than the length of the cross-over span, so that a wire breaking near one of the upper pins would not be long enough to reach any wire of the lower line. The high-pressure wires should preferably be above the other wires.

"2. A joint pole may be erected at the crossing point, the high-pressure wires being supported on this pole at least three feet above the other wires. Mechanical guards or supports must then be provided, so that in case of the breaking of any upper wire, it will be impossible for it to come into contact with any of the lower wires.

"Such liability of contact may be prevented by the use of suspension wires, similar to those employed for suspending aerial

telephone cables, which will prevent the high-pressure wires from falling, in case they break. The suspension wires should be supported on high-potential insulators, should have ample mechanical strength, and should be carried over the high-pressure wires for one span on each side of the joint pole, or where suspension wires are not desired guard wires may be carried above and below the lower wires for one span on each side of the joint pole, and so spread that a falling high-pressure wire would be held out of contact with the lower wires.

"Such guard wires should be supported on high-potential insulators or should be grounded. When grounded, they must be of such size, and so connected and earthed, that they can surely carry to ground any current which may be delivered by any of the high-pressure wires. Further, the construction must be such that the guard wires will not be destroyed by any arcing at the point of contact likely to occur under the conditions existing."

Those two mean: (1) is a short span where the span is high enough and short enough so that the wires on the upper line cannot fall on the wires of the lower line. The second method (2) is to put up a pole directly at the crossing so that the wires of the upper line cannot cross with the wires of the lower line.

The third method:

"3. Whenever neither of the above methods is feasible, a screen of wires should be interposed betwen the lines at the crossover. This screen should be supported on high tension insulators or grounded and should be of such construction and strength as to prevent the upper wires from coming into contact with the lower ones.

"If the screen is grounded each wire of the screen must be of such size and so connected and earthed that it can surely carry to ground any current which may be delivered by any of the high-pressure wires. Further, the construction must be such

that the wires of screen will not be destroyed by any arcing at the point of contact likely to occur under the conditions existing."

The telephone companies are using screen methods, the last method described, and directly above the screen, between the poles so that it will be in the center over the screen, a ¾-inch hoisting cable, which is securely grounded at each end of the span. That cable is carried down each pole on each end of the span and several feet of it is coiled up in a good-sized coil and that is placed in a bed of charcoal at a depth of five or six feet in the ground, to get down to moist earth. A short span is used wherever it is feasible. The chief difficulty seems to be that in the majority of cases the crossings are of such a nature that the short span is prohibited because of the necessary height of pole. I think there is a tendency to avoid the joint pole scheme, as it is considered better policy to keep the wires mechanically separate if it is possible to do so and not put them on any one common structure.

In the same "Electrical Code" under "Miscellaneous" there are a few rules relating to signaling systems which are interesting, but perhaps too long to read. They relate more particularly to the use of protective devices, the methods of bringing wires into buildings where high tension wires are used, and also relate to the use of subway systems for use of high tension wires. The question of induction from these high tension lines, I think, is of secondary importance to the question of the hazard from the crossing of such lines. The induction from ordinary high tension transmission lines which are metallic, or three-wire systems, is not serious until they come to ground the line. That is, in good normal condition, the lines being balanced, induction can be gotten rid of. If the high tension lines are a reasonable distance away—the width of the street—there is usually no trouble. The moment one of these high tension lines becomes securely grounded on one side the induction usually appears with a large increase of intensity; and that is practically the case of the exposure to the single phase railway circuit that Mr. Miller spoke

of. Then you get the very worst condition you can get up against, and there is almost nothing to do but to get out of the way. The difficulty arises from the fact that the power system is still operative when that ground is on the line. They will lose no opportunity to make the service absolutely continuous, and continue to work as long as they can.

President: Now, gentlemen, we have some other papers here, and if there are no further remarks on this paper of Mr. Camp's we will pass to the next paper.

Secretary: The next paper, Mr. President, is entitled "Some Notes on Breaks on Overhead Wires and Proposed Remedies," by Mr. Maver.

President: Are you ready for your paper, Mr. Maver?

Mr. Maver: Yes, sir. I make no apology for bringing this subject to the attention of this body, but I do apologize for the disjointed shape of the paper. I was not sure until I came here that there might not be a paper on this subject, and did not know that there was not until I had made inquiry on my arrival here. So when I found there was not, I voluntered to write some notes on the subject, thinking it would bring out some discussion and information relative to the practice prevailing in different parts of the country to overcome this exceedingly serious difficulty. As the title of the paper states, some proposed remedies are mentioned.

NOTES ON SAFEGUARDING RAILWAY TELEGRAPH LINES AGAINST DAMAGE FROM SLEET AND WIND STORMS.

By Wm. Maver, Jr.

The matter of how best to safeguard overhead telegraph lines against collapse due to sleet and wind storms is one that is of deep interest to telegraph, telephone and electrical engineers in general, but especially to telegraph and telephone engineers, because of the greater number of wires and greater length of pole

lines with which they have to do. It is a subject that has given telegraph engineers of this country and Europe much concern for over fifty years. Comparatively few parts of the world where telegraph and telephone wires exist are altogether free from the ravages of these storms. Shafner records a disastrous sleet storm that occurred in this territory, Tennessee, Georgia and Kentucky, which prostrated 900 miles of single telegraph line to such an extent that communication was not restored for over six weeks. Severe sleet and snow storms are common in Canada, in the New England states, in Great Britain and in the various parts of Europe and Asia, resulting very frequently in great damage to the telegraph and telephone wires.

The most obvious remedy for this evil would be to place the wires in cables underground. This plan, however, appears to be prohibitive owing to the great expense that would be entailed and the electrical difficulties that would ensue in the operation of underground circuits.

In Great Britain an underground telegraph cable of about ninety conductors, has been laid from London to Carlisle and the intention is to continue this cable to Glasgow. Its cost is about $6,090 per mile. The cable was imperatively demanded by the merchants of the country to avoid the total interruption to telegraphic communication due to sleet and snow storms which have been of frequent occurrence in that country. Owing to the topography of the country a sleet storm affecting only fifty or sixty miles of country has more than once interrupted telegraph communication between London and Glasgow for forty-eight hours at a time. It is expected that any section of the overland lines that may now be temporarily prostrated by storm may be "bridled," so to speak, by a corresponding section of the underground cable.

Dismissing the matter of placing the railway wires of this country in cables underground, on a large scale, as impracticable, the next question to consider is what can be done to insure the

sufficient stability of the poles and wires to withstand the storms to which they are subjected.

One proposition is to use two poles side by side, with the cross-arms between them. Another is to use a greater number of single poles per mile than has been the practice hitherto. Mr. L. B. Foley, the superintendent of telegraph of the Delaware, Lackawanna and Western Railway, informs us that he has used 100 poles to the mile with much success on a twenty-mile section of the wind-swept Pocono plateau. Another possible plan is the use of much shorter poles, using the ordinary number per mile. Short poles obviously give a much greater stability by reducing the leverage upon or by which the wind and ice-laden wires is greatly reduced. One objection to the use of very short poles is that they bring the wires easily within the reach of wire pilferers and mischievously-disposed persons. Another is that they bring the wires too near the brush wood, especially in localities where vegetation is rapid.

Another plan is the use of high towers as now adopted by several long-distance transmission companies, using 40,000 to 60,000 volts. For this purpose metal towers, forty to sixty feet high, twelve or fifteen to a mile, are employed. Three to six heavy transmission wires are used. Of course, this construction is massive, cross-arms and insulators being proportionately heavy. The expense of the towers is compensated by their greater durability and the comparatively small number of cross-arms and insulators required. This plan, however, is not considered applicable to railway telegraph lines.

As possible preventives of the formation of sleet on the wires some one has proposed greasing the wires. It has also been suggested that the extent to which the conductors of high tension transmission wires are heated by the current may be sufficient to keep the temperature of the wires above the freezing point of water.

Now, in closing, it seems to me, Mr. Chairman, that this sub-

ject is of sufficient importance to warrant the Association in taking it up vigorously to the end that all the information obtainable on the subject and the best views of all concerned may be gathered. I would therefore suggest that a committee be appointed to take up the subject, to report at the next convention. For one, I should be pleased to co-operate on such a committee, as the subject is one in which I have long been interested, and if Mr. Bristol will act on it to represent the telegraph interests, and Mr. Fowle the telephone, with two or three of your own very able men, some interesting and perhaps valuable data would be forthcoming.

Mr. Selden: I think I can explain the short pole question on the Pennsylvania Railroad, which will unfortunately take some of the romance out of that portion of the work that has been referred to. There was a little difference of opinion, or something else, that occurred betwen the Western Union Telegraph Company and the Pennsylvania R. R. and it was quite necessary for them to assume different positions than they had occupied, so far as their telegraph wires were concerned, in the section between Philadelphia and Washington. It was necessary to erect poles and very quickly, and on account of poles being quite scarce, they were cut in two; I was told by the superintendent, Mr. Andrew Kaiser, that the only difficulty they had experienced was that the people in some of the towns insisted on taking them for clothes lines, but that they had succeeded in cleaning that out, and now their lines work very well.

President: Are there any other gentlemen to make remarks on Mr. Maver's able paper? I am sorry Mr. Bristol is not here this morning. I will say that Mr. Bristol, as General Superintendent of Construction of the Western Union Telegraph Company, got out a new set of rules, which if carried out will overcome a great deal of trouble.

Mr. Selden: While it occurs to me, I will say that we have erected lines with from 35 to 70 poles to the mile, where we haye

some very severe storms, but I notice with all of our care along this line, that in a little bit of bad weather they work very poorly, and, having in view the mountainous sections of the east, where it is hard to find one straight mile upon which the poles remain on one side of the track and where the road is necessarily crooked we find that we have to get in at least one-third of these guys to the number of poles on the track. I recollect many years ago (so many that I want to forget the number), when we had to have lightning rods on our poles, and the result was that by and by we could not use the lines at all. We finally cut the lightning rods down. In regard to the guy proposition, which you cannot always put away from your wires, you notice how close they come to the glass on your cross-arms. I believe something should be done to these guys to insulate them from the earth. To those who only use few of them, of course, it does not cut much figure, but I am satisfied that in the guy question we are repeating the old history of the wire which we used for lightning protection, without knowing it, and I think in some sorts of weather it will give us a great deal of trouble.

Mr. Healey: I will suggest this: In Chicago (paying attention to Mr. Fowle's remarks) we are forced to use joint poles. We are carrying 4,500 Chicago Telephone, Western Union and independent telephone lines. Our method of guying is putting breaks into every guy wire. In some instances we put in two breaks. It is somewhat expensive; it costs about $3.20 apiece, but nevertheless we could not operate if we did not have them. I might say, where you come in contact with high tension currents similar to Mr. Miller's, if you follow this plan of putting the guys into the earth you will eliminate this trouble.

Mr. Miller: As Mr. Bristol is not present—I am sorry he is not here to give his experience with this question—I will just say a word from what information I have on the subject, and that is, between Philadelphia, New York and other places on the eastern division, they have set about 80 poles to the mile, in order

to prevent the breaking of wires when overloaded with sleet. Now there are two problems to solve: One is to give to a wire support enough so that the weight of the sleet will not break the wire, and the other is to prevent the pole from breaking. You can keep the wire from breaking by adding enough poles, and they tell me the increased escape from number of poles does not amount to anything very serious; so that if you set 75 to 100 poles in the line you will eliminate the question of broken wires if the wire is good. The next question is to prevent your poles from breaking. The greatest trouble I have experienced is when the wires are laden with sleet and there is a stiff wind. The wire will catch so much wind that the poles will commence to vibrate, and they will go down for miles at a time. The question is how to prevent that. The only solution I see now is to use anchors. Anchor your lines both ways. Your poles get weak in a very few years at the top of the ground. The only way is to support your pole, and I connect the anchor line immediately under the lower cross-arm. That will give your poles strength enough to resist the wind vibrating and swinging the wire. Now, if you want to try the experiment of putting in say 80 poles to the mile in sections especially afflicted with sleet, and then put on two anchors to each pole, I think you can build a line that will stand sleet storms, but it is a little expensive.

Mr. Kinsman: It seems to me that we can cover both the point Mr. Selden has made and the point Mr. Miller has made—get away from the ground current and also get the strength to support the poles, by using pole braces and throwing out your anchors. I have pled for that in a good many cases, and wherever we have gotten it we have not had any trouble. In rebuilding especially you can get good braces from the old poles, at practically no expense.

Mr. Miller: That question of pole bracing is a little treacherous. I had a red cedar line where I was not afraid of the poles breaking off at the top of the ground because they were very

large and strong, and we braced the poles, locating the braces say one-half way between the ground and the cross-arm; and the first sleet storm broke off nearly all the poles just above the brace. So there is another trouble that comes in there, and that is, when you use an old pole for a brace, that old pole is pretty well gone. It may stand for four or five years, but it fails just about the time your pole gets weak. That is when you want your support. You build new telegraph lines and the poles are good and strong enough to take care of themselves for five or six years, and then you find your brace is of no account.

Mr. Selden: We used to use anchors by putting a stump or piece of pole in with which to anchor. In the course of a few years, as Mr. Miller says, you go along the line and they would look like teeth that the dentist had pulled, and were not doing any good. They were not in the ground at all. Of course, if we could have two braces for every pole we would have a very stiff line, but from my experience I think you would then find the same trouble you cite with the pole brace. In the blizzard of 1888, which was a very severe storm in the east, we had some very strong poles. They were carrying twenty wires, and where the pole would not break or would not split in the ordinary way, or would not be thrown over by the storm, it broke underneath the cross-arm, and the whole cross-arm went whirling into the field. I do not think there is any better way than to increase the number of poles to the mile. Then guy those thoroughly, but by all means break the guy. I am satisfied that a lot of our eastern lines to-day through the mountains of New York, Pennsylvania and West Virginia would give us much better service if every guy we had on there was broken and insulated.

President: Gentlemen, there was a motion made, I believe, by Mr. Maver, for a committee.

Mr. Maver: Just a suggestion.

President: A suggestion made.

Mr. Kinsman: I suggest that the man who made the suggestion put his suggestion in the form of a motion.

Secretary: Mr. Chairman, we know Mr. Maver's modesty. Some of us are not afflicted so much that way. I move that a committee of five be appointed to look into this matter and to report at our next meeting.

Mr. Kinsman: I second the motion.

President: Gentlemen, you have heard the motion made and seconded that a committee of five be appointed on pole construction. All in favor of that will say aye. The motion is carried. I will appoint on that committee Mr. Maver as chairman, Mr. Bristol, Mr. Fowle, Mr. Foley and Mr. Kinsman.

Are you now ready for the election of officers?

Mr. Selden: Have the committees reported yet? If I am not out of order I wish to state that I was chairman of the committee to confer with the American Railway Association on the subject of movement of trains by telephone. I have no report to make other than this: It was suggested by some of our superior officers that a good plan would be for me to take it up with the Train Rule Committee first, and then have it brought before the Association if they deemed it of sufficient importance. At the December meeting in Philadelphia I spoke to a prominent member of the train committee on the subject, and he said he would be very glad indeed to take it up and the Committee on Train Rules would notify me when they could receive it. In the pressure of affairs they evidently forgot about it, and I had intended before this meeting got around by two or three months to jog their memory by stating that we would like to have a chance, but I was doubtless remiss in that also, and between the two of us we did not get together. In the meantime, however, the railway company had decided upon its set of rules, and it might be a good thing for the Association to allow that committee simply to report progress and go on for another term, or to select another committee for that same purpose. We are operating under our rules quite extensively. Just before I left home I signed the usual forms for thirty-four stations on one single piece of track.

Our company is not figuring at all on displacement, nor have we displaced a single telegraph station. We are using this as an auxiliary at telegraph stations and at outlets of long passing sidings. It is of very great advantage to us. We could not very well establish telegraph points there, but the establishment of telephone lines there under these rules has very materially expedited the traffic and reduced the overtime.

Mr. Van Etten: I move that the committee be extended to cover another year.

Motion seconded, put and carried.

Mr. Camp: I would like to ask Mr. Selden if they give meeting orders and crossing orders over this portion of the line by telephone, or simply give the time on regular trains.

Mr. Selden: The ordinary use is to facilitate the movement on single track block. The train instead of staying at Station A, if this is used, will proceed on a passing siding two miles in the direction of Station B. When the train which is opposing it has passed it, they report by telephone to Station A that that train has passed. Station A then arranges under the usual block rules with Station B. This train will then proceed to the outlet switch at Station B, and entering there will report that they are in to clear, when the block will be considered clear. You will see by this that it cuts down your main track block just to the extent of your passing siding. At non-telegraph stations they will send orders whenever it is necessary. For the time being, it is the practice to send such an order as will admit of that train going to the first telegraph station, where they can handle it by a further telegraph order, but it will not be long before they discover that they might just as well make them meet further beyond, and that will doubtless be done.

President: There is a vacancy on the committee on the use of telephone for train orders—Mr. J. H. Jacoby. I will appoint Mr. J. S. Stevens of the C. & O. on that committee. That makes the committee read Messrs. Selden, Griffith and Stevens.

We have some papers unfinished for the afternoon session, but the next in order is the election of officers. The first is election of President. Nominations are now in order for the office of President of the Association of Railway Telegraph Superintendents.

Mr. Kinsman: Gentlemen, I beg to place in nomination Mr. E. A. Chenery, of the Missouri Pacific, St. Louis.

President: Mr. E. A. Chenery is nominated. Any further nominations?

Mr. Griffith: I move the nominations be closed.

Mr. Selden: I move the nomination of Mr. E. E. Torrey.

President: Mr. E. E. Torrey is nominated for the office of President. Are there any further nominations?

Mr. Chenery: I beg to withdraw in favor of Mr. Torrey. Mr. Torrey having served as Vice-President, I think the honor should be conferred upon him.

Mr. Selden: I move that the nominations be closed.

Motion seconded.

President: Moved and seconded that the nominations be closed. That leaves us with the nomination of Mr. Torrey. All in favor say aye, contrary no.

Mr. Selden: I move that the Secretary be instructed to cast a ballot for Mr. Torrey for President.

Motion carried.

Mr. Selden: I move the nomination of Mr. Chenery for Vice-President.

Motion seconded.

President: Any further nominations?

Mr. Foley: I move that the nominations be closed.

Motion seconded. Carried.

Mr. Selden: I move that the Secretary cast a ballot for E. A. Chenery for Vice-President. Seconded and carried.

President: The election of Secretary and Treasurer is now in order.

Mr. Selden: I move that the Secretary be instructed to cast a ballot for himself, as usual.

President: I second that motion. Moved and seconded that the Secretary cast a ballot for himself. Mr. Secretary have you done so?

President: I declare Mr. P. W. Drew elected as Secretary and Treasurer. I will appoint Mr. Selden and Mr. Williams to escort the new President to the chair.

Gentlemen, allow me to introduce Mr. Torrey, the new President of the Association, and I present him with this gavel.

President Torrey (in the chair): Gentlemen, I thank you very much for the honor bestowed upon me in making me President of this Association, and also for your enthusiasm on the subject and your hearty hand-clap, and I will endeavor to do the best I know in the interest of the Association. I believe the next thing in order is for the Vice-President to make a few remarks.

Mr. Chenery: Gentlemen, I sincerely thank you for this mark of appreciation, and I beg to assure you that I will render all assistance possible to the President, to the officers of the Association, and to the members.

Secretary: Mr. President, we have a Committee on Cipher Code, none of which are present, but we do have a Committee on the Typewriter in Railroad Service, of which Mr. Williams is the chairman.

Mr. Williams: Mr. President, the former chairman of that committee reported two years ago. The matter was presented to the American Railway Association and I understood that this committee was simply continued in case the American Railway Association should want some information, so nothing has been done. The committee has not been called together and I move that the committee be discharged.

Motion seconded by Mr. Kinsman.

Mr. Kinsman: In that line, Mr. Chairman, I presume it would be proper to state for the benefit of any who might not have read the proceedings of the last meeting of the American Railway Association, that the matter has been definitely arranged and that the books are already in print.

Secretary: That is for the Cipher Code Committee. The present committee is for the use of Typewriter in Railroad Service. The Cipher Code Committee has died a natural death.

President: Gentlemen, you have heard the motion that the Committee on Use of Typewriter in Railroad Service be discharged. All those in favor please say aye, contrary no.

Motion is carried.

Secretary: The next committee is Committee on Composite Circuits, of which Mr. Fry is chairman, who is not present, and Mr. Weidman has now left us, leaving Mr. Foley as the remaining member of that committee.

President: I would like to hear from Mr. Foley on the subject.

Mr. Foley: Mr. Chairman, I have not done anything in that matter, depending entirely on the chairman. I supposed that he would be here. I think, however, that Mr. Fowle can give us as much information on that subject as anybody. In fact, more than any of our own members, because he is thoroughly acquainted with the subject.

President: Mr. Fowle, will you please tell us something about this?

Secretary: Mr. Chairman, if I may be allowed to interrupt, it is now 12 o'clock, and I think it would be well for us to come together and start in with that at the afternoon session. When we get started on composite circuits we cannot stop and do not want to stop. I move that we adjourn now, to meet at 1:30 o'clock.

Motion seconded and meeting adjourned till 1:30 p. m.

AFTERNOON SESSION.

May 18, 1905, 1:30 p. m.

President: Come to order, gentlemen, please. I believe the next matter in hand is the announcement of the committees. I have the following names: Committee on Local Arrangements, J. J. Burns, C. A. Parker and J. Munday. Committee on Topics, V. T. Kissinger, F. H. Van Etten and S. K. Bullard. Committee on Composite Circuits, U. J. Fry, G. H. Groce and R. L. Logan.

We listened yesterday with a great deal of interest to the discussion on composite circuits, which matter was left open to be completed to-day, and I will now ask Mr. Fowle if he will please give us some more remarks on the subject.

Mr. Fowle: I think Mr. Foley referred to the grounded composite. Is not that so, Mr. Foley?

Mr. Foley: Not particularly. I think we should like to hear about the grounded and the metallic both.

Mr. Fowle: The use of the grounded composite circuit on the grounded telegraph wires I think you are all pretty familiar with. A good many of you are using it, the use of which has increased considerably during the year, and recently I have figured that about 20,000 miles of single wire are now composited with the grounded or railway composite. That is, are in use. Upon symplexed circuits there has not been very much difficulty, and the composite is also working in certain instances on duplex circuits. I think Mr. Van Etten is using it on his road from Chicago to Danville, getting telephone service out of a copper wire used as a quad, without any choke coils in the circuit. Attempts to use composite on quadruplex circuits do not seem to have been uniformly successful. There seem to be conditions not thoroughly understood or mastered as yet with the metallic circuit composite and the grounded circuit composite, still I

think the chief difficulty has been with the ringing apparatus. That constitutes the bulk of the complaints that have been referred to me, and perhaps that is the weakest feature of the whole thing. I think in the large percentage of lines it is working satisfactorily. In the majority of cases where there is trouble with ringing apparatus, it is due to long lines with a good many intermediate stations, and I think perhaps the limitation of the ringing feature constitutes the limitation on the system. The ultimate development of the grounded composite will be one circuit per mile of pole line all over the country, which means one mile of circuit per mile of single track throughout the country, and could not exceed much over 220,000 miles of circuit, and the total development now reaches about 10 per cent of that. The metallic circuit composite is in considerable use, the Lehigh Valley using it from Jersey City to South Bethlehem, getting a morse circuit out of each side of the metallic circuit, and they use one of the high frequency ringing devices, and the operators ring without its interfering with the telegraph service. The symplex is also in considerable use. I believe Mr. Ryder is getting a quadruplex circuit from one of his telephone circuits by means of the symplex system.

Secretary: Perhaps you had better explain the difference between the symplex and the composite.

Mr. Fowle: The composite secures from one metallic telephone circuit two telegraph circuits. That is, each side of a metallic circuit is used also as a grounded telegraph line.

The symplex system secures only one telegraph circuit from the metallic telephone circuit. That is, the symplex system is not possible with the grounded telephone line. I think the symplex system is used a little more extensively than the metallic composite because it is a little more flexible and meets general conditions better. I do not know that I can say very much more about it. It will be more interesting to hear from different members who are using this apparatus.

President: We would like to hear from some other members of the Association on this subject. Perhaps Mr. Parsons can tell us something.

Mr. Parsons: We have not had very much experience with the composite, only working three circuits at present, one with four instruments and the other two with two instruments. The one with four is 80 miles in length, and we get very good service out of that. We do have some trouble in ringing, but the talk is good at all times.

There is one thing that I would like to ask about, though, regarding the grounded composite. All the papers that we have heard tell about the advantages from a telephone standpoint, but they do not mention anything about the disadvantages from a telegraph standpoint. When an operator complains about the working of the wire and the trouble is said to be caused by the composite, he is generally told that it is his imagination. I do not believe that. The trouble is caused by the condensers or by the bridging around. It seems to me there ought to be some way of figuring on a standard for a certain class of wire, so that we will know just how many instruments a certain wire will stand. If we had an iron wire of a certain gauge would it stand three or four instruments. I presume that could be figured on.

Mr. Ryder: I think that you all agree with me that the success of the grounded composite very largely depends on the condition of the wire itself. I mean the telegraph condition of that particular wire. A first-class working wire telegraphically will give better results telephonically than a poorer telegraph wire. In other words, if you have a high potential telegraphically you can stand a certain amount of ill effect produced by the induction of the composite apparatus without its being particularly noticeable, but if you attempt to get telephone service out of a long, hard-working telegraph wire, you are bound to feel it and your service will be poor. On four circuits, each one of these circuits made up of 210-lb. copper wires, the longest one 206 miles long,

has three intermediate drops, two of them connecting with private branch exchanges—that makes the circuit practically a trunk line connecting with four private branch exchanges—the third drop being simply an instrument in a local residence; the other three circuits are not long, the longest being 120 miles and merely connected to terminal private branch exchanges, the telephone service is perfectly satisfactory and the effect on the quad is not serious enough to be ordinarily noticed.

Mr. Fowle: I think in reference to Mr. Ryder's answer to the question about the margin on heavily loaded telegraph wires, when you stop to consider the amount of business that is handled on a long telegraph circuit, especially iron circuits, with a good many way stations, you will find you are handling a good deal of business pretty economically over such a circuit for the money invested. You are probably getting all back from it that you can reasonably expect, and that the greatest advantage from composite systems comes from circuits that are not burdened with too many stations, either for telephoning or telegraphing. An iron circuit three or four or five hundred miles long, with way stations every twenty-five miles, or something of that sort, represents a telegraph line that has not a great deal of margin, especially in bad weather, and when you attempt to composite such a line in two or three sections, possibly even in one, it represents a condition where there is not working margin enough to meet all conditions successfully.

Mr. Selden: I have not had the opportunity to look closely into this very admirable paper of Mr. Fowle's on the railway telephone service, and I simply want to call attention to one or two things that strike me hurriedly, for fear he is figuring from a premise that might mislead him. On page 9 he states that the useful life of copper is fifty years, and fifteen years that of iron. That is not exactly right. As to the useful life of iron wire, it depends first on whether your wire is iron or not. There has been no iron wire manufactured in this country for telegraph purposes in fifteen years. You get a low, soft steel instead of the

old Norway iron, and your extra best is not an iron wire. Now such a line as that in certain territories in Pennsylvania, Maryland and West Virginia will not last and be an efficient wire beyond ten years, whereas west of the Ohio river, in the open or prairie country, it is perfectly good for twenty-five years. Barring the new points that might come in by reason of storm, which can be remedied, of course, that wire is almost as good as when you first put it up, if you can get iron wire to start with. If you have steel wire there is even then the greatest sort of a difference, and therefore the figures are apt to mislead. I speak from experience, because a first-class wire strung in 1893, was dust in 1901, whereas wires strung in 1875 are good, effective circuits to-day west of the Ohio river. There are not many of us who know that owing to the peculiar arrangements of the steel people we are not getting any iron wire, and have not been for some time. I think, therefore, that it is right to call attention to the difference there, which would cut a decided figure possibly in these costs as made up in the tables. Now the relative efficiency of the telephone and telegraph I find are based on an average speed of conversation of 125 words per minute, while that of morse is 30. I am using the minimum figures; and the traffic capacity as shown here is that the telephone circuit will equal four of the morse circuits, and that the cost of the telephone will be—well, one-ninth, in round numbers, of the telegraph. This I think could not be borne out by the facts. In the first place, talking at the rate of 125 words a minute, using the minimum figures, by anyone, for four consecutive hours, would pretty near wear out that voice, and you would have to relieve that operator at least every five hours, and it would take in the nine hours not less than two telephone operators to talk, which would make this figure 120 instead of 60 as shown. Again, the use on railroads of the telephone, or rather of the operator, is such that we cannot hire competent people for $30 a month to perform service that we require, either as receivers of orders, attendance of signals, or anything else at the rate named herein. Therefore, I hardly

think it is fair to make the figure as shown by Mr. Fowle. I feel that where you have a large amount of business between two terminals, it can be handled with equal efficiency and at slightly less expense by the telephone as compared with the morse. That is to say, if you have a circuit between A and B that is busy all the time with the morse, you make that a metallic circuit and place upon it the requisite number of telephone operators to both send and receive for a given number of hours, and your service will be more expeditiously performed and as thoroughly well done as it would be by morse; but that applies, I feel, only to those points and those circuits wherein between terminals you have enough to fill your circuit all the time.

I am sorry that I have not had time to go a little more fully into an analysis than this, but these two cases I have brought up seem to me striking, and I think they will bear revision. I think the difference between the opinion herein expressed and my own is due to the fact that our friend Fowle has figured from a premise of his own, while we take the other ground, and the view, therefore, is somewhat different.

Mr. Fowle: In regard to the opinion of Mr. Selden as to the iron wire, one object I had in putting up that analysis of figures was to bring out a consensus of opinion, and, of course, local conditions affect any particular proposition.

In regard to the traffic capacity, I think Mr. Selden assumed that I was paralleling the telegraph and telephone circuit, assuming that there was an operator at each end of the telephone circuit who would handle the business much as a telegraph operator would over a telegraph circuit. Perhaps I did not make it clear, but I had in mind a private branch exchange proposition. I think, probably as to private branch exchange operators, $30 is a minimum figure. Where that is the case, and a telephone trunk line is erected between two private branch exchanges, the volume of traffic over the trunk line as compared with the volume of traffic within the private branch exchange, as to the number of calls

that are local to the private exchange, is probably small, so that the large burden of cost of the operator should be charged to the business of handling the intercommunication and not to handling business over the trunk line. However, conditions may vary at that. I do not think that it affects the conclusion materially as shown on page 17, beginning with the last paragraph:

"The conclusion is that economy in wire use consists in building moderate-haul telephone lines for simultaneous use, arranged to handle the long-haul business by telegraph. When there are special uses for long-haul telephone circuits, they are no more expensive than morse circuits except for very long hauls above 1,200 miles. On railroad lines where the traffic of transportation is light or moderate, and where one train-dispatching circuit and one combined business and commercial circuit are sufficient, the business can be handled most cheaply by telegraph. The very long-haul traffic, also, can be handled by telegraph most cheaply. On railroad lines where there is heavy transportation traffic, it is usually the case that the traffic of communication is correspondingly large; and this is the economic field of the telephone, worked simultaneously with the telegraph."

I think the figures and the tables of cost in here may be very considerably changed to meet individual local conditions without changing the conclusions to be drawn very materially. I would like to hear from Mr. Selden if he agrees to that.

Mr. Selden: I agree with it in part. I agree that a telephone exchange operator getting $30 a month can make a connection to reach another private branch exchange, and I expect the general superintendent who gets $600 a month and talks over there will probably cost in the end more than though he had dictated the message and let the telegraph messenger send it who gets $75 a month. In other words, he ought to apply the time of high priced officials in doing the talking, and you lose sight of that in your figures. I don't mean to say that high priced officials cannot talk and reach a conclusion more quickly by telephone than by telegraph, and that it is not a good thing,

but I think you ought to figure in what it does cost to telephone. You know what it costs to telegraph, and if all the messages were written and sent by telephone, you would then know what it would cost in that way. I am, of course, not opposed to competent telephoning. I believe you have the largest circuits in the United States; but I do not want our enthusiastic friends to go too far on the other side of the house, and have some of our general managers asking us why we do not do so and so, when the conditions will not admit of it, and when the figures are not exactly right.

Mr. Fowle: The only reply I can make in regard to the time occupied by high salaried officials is that the greatest use of the telephone, I think, is by the subordinate, and there may be ten uses by the subordinate to one made by the high official. The subordinates use the telephone a great deal more than their superiors, and these employes might naturally consume a great deal of time in getting messages through a telegraph office. Perhaps all stations would not be in a position to dictate those messages. Perhaps they would have to write them out in longhand and consume their time, and that perhaps is an offset on the other side.

Mr. Selden: The theory is that when you put in service a telephone, you reduce your telegraph traffic. That is the theory. My experience is it does not do anything of the kind. My experience is that it handles the business of the company more rapidly at times and is a very desirable thing, but when it comes down to car tracing, train orders, or anything regarding the movement of cars, which they want to keep a record of, even if they are going to use the telephone they will have the message written out in the ordinary way. The telephone can be used to very great advantage by all railroads, and is to-day more than they know of, unless it would go out of existence suddenly, and then they would wonder what in the world they did without it; but so far as my experience goes with our private branch exchanges and all of it, our telegraph business grows constantly just as the business of the railroad grows.

Mr. Fowle: I think if he said that the railroad business was not growing constantly, he would get a reduction of telegraph service by using the telephone, but it may be that the telegraphic service does not meet the actual increase, and therefore the telegraphic business keeps growing. I have not had in mind that the telephone would in any sense supersede the telegraph, but my object was more to point out the telephone as the most economical use, and the use of both telegraph and telephone at the same time. I think Mr. Groce can give us some information on that subject.

President: We would like to hear from Mr. Groce.

Mr. Groce: I think Mr. Selden's point in regard to the record necessary is one that is probably overlooked, and may be not thoroughly appreciated by Mr. Fowle in his paper. Probably he is not acquainted with the requirements of the railroad business in certain ways which make it necessary to have this record. The Illinois Central are using to-day about 1,500 telephones. In a large measure the advent of the telephone brought with it a new business, and our experience has been like Mr. Selden's, that the telegraph business has continued to grow at about the percentage that it increased before the telephone was brought in. The use of the grounded composite is limited with us for the reason that it costs too much money. The material that the ringing battery consumes will amount to more than the interest on an investment for another wire. For that reason we abandoned some of the grounded composite circuits that we put in a year or more ago. We have one or two circuits working very well and would be glad to extend this use, and there are many places that we could use it if we could find some way of calling that would not require the cost of the present instrument. The use of the telephone is not with us extended to handling train orders, but we have what might be called an operator's block under which we use a block instrument that requires the service of two men simultaneously to allow a train to enter the block. That is, to clear the signal for the train. The men at each end of the block keep a train record. That is familiar to everybody

who has handled a telegraph operator's block. We have each one of these offices connected with a ground telephone circuit. It is not our intention to use any more iron wire for any purpose, and no copper wire smaller than 210 lbs. per mile. We have quite a lot of wire on poles of 170 lbs. that is being replaced by heavier wire, and we are using that wire for this ground telephone circuit, extending along each block, one telephone at each end of the block. We find the service very good and all of our circuits work as well as the metallic of any of the cities with which I am acquainted. We have now in operation about 1,600 miles of metallic circuit telephone, and were it necessary we figure that we could, by cutting this long metallic circuit into divisions, putting every other office on there as a telephone office with a local telephone, about handle the business without telegraph operators, if they got scarce. At times now we have used men who were not operators at a block office. The Illinois Central in considering the style of block installed, investigated all of the different automatic systems and manual systems, and it was decided that the automatic could be used entirely upon double track and the signaling of all double track could be carried out as fast as we can do it, with the idea of doing away with the use of a 31 and 19 train order entirely on double track. Our single track blocking was made manual for the reason that we thought it would help us in the movement of trains. The original investment was a great deal less. In fact, not over $200 per mile with us, as against an average of say $1,000 or $1,200 per mile for automatic and the money expended in making automatic we spent in operators, and have a night and day telegraph operator at each passing track. The first installation was made about a year ago, and since that time we have extended over several heavy single track divisions, so we now have about 325 miles blocked, and we are installing 300 additional miles which will be in in sixty days. We had one division that had a peculiar traffic; a pick-up division; for the overtime three years ago amounted to $3,000 a month; trainmaster's overtime. With the use of this block signal we have increased the efficiency there,

and in April we had 100 trains more than last year, and the overtime less than $300. We think it is due to the opening of these offices, and placing an operator wherever the train gets nosing off the main track. The telephone business has undoubtedly been very beneficial to the handling of trains on a railroad, and I desire to ask Mr. Selden something about the manner in which they handle this limited train order business which he spoke of this morning. It has not been necessary for us to go that far under the manual system of having two men—a night and a day man—at each siding, but there are places that we can use this thing giving time of trains in yards and at terminals, and it has been a question in my mind whether or not we could properly afford to establish that practice without having some code or means of making the men be sure of the meaning of the words that have similar sounds over the telephone. I think I heard Mr. Selden say about a year ago that he had been looking into that and it is interesting for me to know his conclusion.

Mr. Selden: Mr. President, I am sorry I have not with me a copy of the recent rules adopted by our company, but it was the understanding at my office that they would be sent to each member of this Association. I find some of the gentlemen have them and others have not. The rules governing the issue of train orders are those (210 and 211) of the Standard Code, and in addition the method of transmission is by spelling out the train order. Every letter of every word. To use our illustrations: "Sixty-five" followed by "six five." "Fifty-five, five five." So you get each by the letter, and then instead of "65" and "55" you get "six five" and "five five." We provide in the rules that such a telephone station must consist of a booth at least 4x4 feet, properly lighted with a bracket lamp, with a standing desk. That is, with one or two lights, with necessary stationery—space below for that—and with a box with which they can deposit a copy of the train orders and they cannot get them back afterwards. They are sent in to the superintendent of the division. We arranged with the telephone company through Mr. Fowle, for a peculiarly constructed head telephone. It is swung on a

swivel and hangs on an ordinary hook. For an ordinary call they take that up and put it to their ear, and if a question is asked they answer it. If they say it is a train order or a blocker, they throw the band over their head, which leaves both hands clear, and they are then free to take a train order.

The clearance card is a condensation of clearance cards on one card, divided up in sections, so that I may be at the end of a sidetrack and they ring me up and the operator says "clearance card Section O" and I just fill out and say "You may back out and go to so and so" or "Head out and go to so and so," as the case may be. The telegraphic orders for movement of trains are sent to the nearest telegraph station, from which it is repeated. The telegraph operator repeats back to the relaying office and the relaying office repeats back to the dispatcher and they get it. As I said before, I am sorry I came away in such a hurry; I did not bring any of the rules with me, but it was my understanding that every member was to be furnished with a copy of the rules before I started. While there is nothing strartling in the rules themselves, a personal explanation of them is always better understood. We find that superintendents who used to say "yes, they would move trains by telephone in an emergency" are finally concluding that almost every train on earth is an emergency, and there is no hesitancy in using it in the way we have suggested. We feel we have covered the ground pretty thoroughly. To such an extent I believe it is the first railroad authorizing the movement of trains by this block system as well as otherwise.

Mr. Van Etten: Mr. Fowle spoke of the success with the composite set on our quaded wire. I do not think that is due so much to our eliminating the trouble, perhaps, as to the shortness of the circuit. The circuit is only 123 miles long and we have a set at each end, one at Chicago and one at Danville. We have no intermediate drops. We have worked that continually since one year ago last July. We also, when Chicago desires to talk with the division point 40 miles south of Danville, throw the telephone line around our quad set by using a condenser on the quaded line and around the repeaters that work on the polar

side of the quad, and that is used every day at certain times. On that same wire that works into the polar side of the quad we have a composite set at Danville and one at Villa Grove. There we have two terminal boxes in that wire and another telephone line from that point 170 miles south with four composite sets, and we are getting good service out of that circuit, on the telegraph and also on the telephone. There are only three intermediate offices between those four composite sets on that line. That circuit works from Villa Grove to Marion, 278 miles, and it works through a set of repeaters to St. Louis. We have on another circuit iron wire from Chicago to Terre Haute, 178 miles, from Danville to Terre Haute, 54 miles. Between Danville and Terre Haute we have five composite sets. On a bad day we experience some heavy dragging, but by cutting that wire at Danville and working a set of repeaters, the wires work very well and still keep up the composite set for talking. We have had better success for the past six months than before. I think that is due to the better class of instruments, the ringing apparatus and the 'phone. The talking part of it is all right. There is no question about that. That is the test we are having. We have twenty-one of the sets. In fact, every wire we have has sets on it and we have two of our wrecking steel cranes that have portable sets for use.

What we are interested in now is block signals for double track and single track, and I would like to hear all I can on the subject.

Mr. Selden: As to telephoning on quadruplex circuits, we have been unable to have any success on that line at all. When we arrange our resistance, etc., so as to give us good talking circuits, we disable the quad, and when we fix the quad so it is all right we cannot talk. My friend Mr. Fowle promised me about a year ago that that would be fixed, but I have not heard from there yet.

Mr. Van Etten: I understand another gentleman has already fixed that. We would like to hear from him.

President: Mr. Van Etten I think refers to the Western

Telegraphone Company, who are in Room 63 and represented by Mr. J. F. Healey.

Mr. Healey: I refer you to our chief engineer, Mr. Rugh.

Mr. Rugh: We have in Room 63 a telegraphone. We have for the past three years been experimenting along that line, as a great many private members know, and have a number of instruments that are working very satisfactorily and have for the past year, and the signal overcomes the objection as Mr. Groce referred to the excessive use of battery. With the ordinary talking battery we have used in majority of installations the ordinary dry battery of from four to five cells, and for the ordinary use, in many cases extremely heavy, those batteries will last from three to four months, and then, of course, it is necessary to re-charge or put in new ones. I have not made any definite experiments with the closed cell battery, but no doubt they would fill the requirements for a year. We can signal as far as we can talk. That is as far as required. We have placed in operation a line 217 miles long in the southern territory. Of course, not around Chicago; about 100 miles is the practical limit out of Chicago. Of course, it can be over-reached a certain per cent, but conditions have got to be real favorable for that except on a copper circuit, and we work there successfully 183 miles, on a copper quad. That is out of Chicago. We feel no interference whatever on the quad. In fact the capacity we have on the line does not necessitate any change in their artificial adjustment of quads, and we have a train set that was recently put on the market that has an arrangement by which the dispatcher may call the user of the train set as well as the user being able to call the dispatcher, and this does not interfere with the morse wire in any way. I think there are a good many present that have had experience with the 'phones and I would be glad to show any who desire to look into this apparatus what we have.

Mr. Selden: The shortest quad service that I have is 300 miles long. I worked one 573 miles. I would like to know if there is anybody who has had experience in a matter of that kind with copper circuits 210 lbs. to the mile.

President: Anyone here who can give us any information on this subject?

Secretary: Mr. President, if there is nothing else just now, before we hear from our friend Mr. Wilson, who can probably give us some points on this question of signaling for the single track, I would like to suggest that we now have appointed the Committee on Courtesies, who can prepare their report and have it ready to submit to the Association after we hear from Mr. Wilson.

President: I will appoint on that committee Messrs. Ryder, Spafard and Parsons—Committee on Courtesies. Gentlemen, will you please do the needful.

Secretary: Mr. Lang can probably give the gentlemen most of the information.

President: We have all been very much interested, I know, in the paper written by Mr. Fowle in regard to the railroad telephone service and cost of line construction. It has been very interesting, both yesterday and to-day, and I desire to thank Mr. Fowle on the part of the Association for his very able paper.

We now have with us Mr. H. Raynar Wilson, of England, whom I will ask to give us some information in regard to the safe working of trains on single track in his country.

Mr. Raynar Wilson: I think I ought to put myself right, Mr. President and gentlemen, as to the circumstances under which I find myself here. I am not a telegraph man. Whilst I am a railway man, I have amongst other varied knowledge some little acquaintance with telegraph work. Still I am more of an engineer and traffic man, and a signalling man in particular. But I am in this country in connection with the Railway Congress, and noticing that my dear, good friend, your retiring president, Mr. Hope, was to be in Chattanooga to-day, I wrote that I would be very glad to come down here and see him, and he was good enough to wire me and say he would be very glad if I would be present and say something to you.

Now there is one subject that it seems to me is of the most vital importance to American railroads, and it is a subject that will come before you gentlemen, I am satisfied from what I hear, very strongly; and that is the safe working of your single-track roads, to meet the lamentable number of what I call head-on collisions on single lines when compared with the comparative immunity that we enjoy in England on our single lines, seems to point out—I say with all respect, and I trust you will accept all I say with the respect with which it is intended—that there is something lacking that you ought to be in a position to meet. I know from what I have read and what I see that the reliability for the working of single lines in America rests with the train dispatcher, who has before him a certain program according to which the running of the trains is regulated. The program is altered and amended from time to time as trains run late or are canceled or run in duplicate or extra trains are run. So long as these orders that the train dispatchers issue are carried out, there is not so much fear of the rest. From what I read, and I am open to correction, it seems to me that there are times when these orders are mis-read. Very often they are forgotten. Sometimes they are not delivered. Not only that, but you instruct your trainmen to meet a second portion of a certain train at a certain point; this train is perhaps overlooked or is forgotten, or some other train is taken as the particular train in question. I think you quite recognize what the difficulties are and what the situation is, and therefore I come to this: That in our country, whilst we are the home of railways working with the block system, I candidly admit that I do not think we come up to the American railroads in the varied applications with which you make your electrical arrangements such as I have listened to this afternoon. I do not want you to think for one moment that I confess you have greater brains than what we have, but there is in the American nation a tendency to apply the forces of nature that does not come to us quite so readily. We will submit to your aptability, but we are not driven to it through force of circumstances as you are. With us labor is cheap, and with you labor is dear,

and therefore you have to make the very best of your circumstances, which leads to your adopting practices which appear to us smart, but perhaps if we were in the same position that you are, we might develop the same ideas. On the same day that I received the telegram from Mr. Hope bidding me welcome here, I read in the Daily Journal of the Railway Age of May 14, which was last Saturday, an article that may have been read by most of you, but I may be pardoned if I read it—the conclusion of the article, at least. It is headed "Varieties in Block Signaling Methods" and it concludes as follows:

"Except in the matter of manually controlled or automatic block signals, American signal engineers are less progressive than their brethren in some other lands. In this country, to be sure, we have coquetted slightly with the staff instrument, or what amounts to the same thing, the tablet instrument, but no real progress has been made in the study of the question where this form of blocking should be used. It is a study demanded by the conditions of American operation to-day; and the lack of interest shown in this method of separating trains is one of the serious aspects of American train operation. Wherever light traffic exists on a single track, the staff, or the tablet, is predicated by those facts. The length of blocks is most easily arranged to suit particular conditions; blocks may be most easily shortened or lengthened, as the conditions change; and a measure of safety is provided at a cost that scarcely need be regarded. Great problems of signaling confront American engineers. They must be solved either with a full knowledge of what has been done by their foreign contemporaries and predecessors, or in a haphazard and make-shift manner."

That is from one of your own countrymen. I think you will admit that The Railway Age deals with things thoroughly. It is in regard to the methods we have that I want to hold your attention just for a moment. I have seen what the tablet has done for us on the other side. We had crossing orders. The two last railway companies to abandon crossing orders were the Great Western and Highland. The Highland is perhaps typical with

American railroads. It has very long stretches of single line through mountainous country, which is in winter blocked with snow storms. They have excessive traffic at certain times in one direction. They have no end of special trains, so that the illustration between the Highland Railway and the American railroads is to my mind very typical. It was found that the superintendent who dealt with the movement of the trains was finding his work too great. The anxiety of getting these trains not only safely, but quickly over the line, was too much for him, and so they tried the original electrical method of controlling single lines. You all of you are aware that some companies have tried the electrical train staff for working single lines. Another train staff some of you may have seen, which has been on exhibition during the congress at Washington. The Hill Signal Company have just concluded some arrangements by which they act as agents of a modified form of the Webb & Thompson arrangement. There is another system, the oldest system of all, and to which system just a little reference is made in The Railway Age. I refer to Tyer's tablet instrument. Mr. Edward Tyer designed this method of working single lines, which I will take as an illustration of how British roads work. The electrical train staff does the work in the same way. It was brought out subsequently to the tablet and it had certain advantages which some British railways appreciated, inasmuch as it retained the old form of train staff to which the drivers had been accustomed in the days when they had the wooden staff. The tablet is a system that I perhaps know better because there was a time when I had to investigate the tablet and electrical staff, and if I speak now of the tablet it is not advocating the tablet as against the electrical staff, and I believe that what the tablet can do the electrical staff can do—at least nearly as much. Let us say you have a section of single line from A to B. The line commences at A, A being the end of the double line. From B to C is another section, and from C to D is another section. In the tower at A there is an instrument. In the tower at B is a corresponding instrument with the one at A, and there is also still another instrument at C, and so

you go on to the end of the line. In these instruments are placed twenty, thirty or forty (as the case may be) electrical tablets. These were originally made of steel with brass edges. They were found too heavy, and afterwards they were made of aluminum, but now they are made of fibre. When A wants to send a train to B he exchanges the customary bell code signals, and if B is in a position to accept the train he exchanges the signals, depresses a plunger, and A at the same time depresses his plunger, which allows him to pull out a drawer, which presents him with one tablet. Having got that tablet the man at A cannot get another, and the man at B cannot get another. Now you must know that in Great Britain, according to the regulations of the Board of Trade, who govern all our railroads there, we are compelled to have absolute block working on our passenger lines. That is to say, if a train is traveling from A to B, a second train must not go from A to B until the first train has arrived at B. Now that will not suit American conditions any more than it will suit conditions we have to meet in Africa, Japan, Egypt, India and other places where the method is used. The man at A can, with B's permission mind you, get any subsequent number of tablets, but B must give permission for each tablet that is withdrawn, so that B knows just how many trains are approaching him, and can at any moment stop the flow of trains, if any important train arrives at B; or B may refuse to permit another train to enter the section, so that herein lies an advantage over the train staff that the Union Switch & Signal Company have exhibited at Washington. With their permissive train staff, six, or if necessary twelve, eighteen or twenty-four trains may be sent. But B does not know how many of these trains are coming, neither can he stop the flow of trains at any time, but if he could he has to accept one more train, because he must have the permissive staff to put the rings upon in order to put it into his instrument so that the apparatus may be joined up. The point I want to show is this: That B controls every train that comes to him and he knows how many are coming, and at any moment if he has a train coming in the opposite direction he can stop

the flow of trains. Should a tablet be withdrawn for a train that does not arrive, it can be put back. Or if a tablet be withdrawn for a train that is subsequently canceled because B has a more important train to come over the road, it can be put back in the instrument. If there is an intermediate siding between A and B and the train has some work to do there and it does not want to go right through the section, it need only go to the intermediate siding, because he is in complete command of the section, and the tablet can then be restored to the instrument at A and the wires again synchronized. Now, a problem that has to be faced on this side before any tablet or any train staff can be adopted, is the one of exchanging these tablets or staff at speed. Let me assure you at once that we are to-day exchanging tablets in Scotland and Ireland on mail trains on single roads at over sixty miles an hour, so that is a thing you need not face. We have a tablet catcher, but since the fibre tablet has been introduced, it is so light in weight that if the fireman is struck over the arm with a tablet it does not hurt him, and the tablet exchanging apparatus has been dispensed with.

Reference has been made this afternoon with regard to the arrangements that are in force on the Illinois Central as to controlling their single tracks by what I would call the lock and block, or manually controlled. I like that idea, and I am very glad to welcome anything that will go toward securing the safety of single track, but there does seem to me an advantage that the electrical staff or tablet enjoys, which is, the driver who carries the train has with him, in the tablet or electrical staff, some tangible proof that he is in possesion of the road. I am told that on the Illinois Central it is arranged that before the driver proceeds on to the single line section he has to see the signal lowered, and that is an indication that he is in possession of the road. That goes some of the way. I do not think it goes all of the way towards meeting my objection. But it seems to me you are up against a problem I have already referred to, which is that all the trains will then have to reduce speed, because if the stop signal cannot be lowered until the driver sees it he has no indi-

cation that the section ahead is clear. He must therefore reduce speed, which is one of the objections I understand raised against the adoption of the electrical staff system. There may be other points that I might bring out, but probably some of you gentlemen present may wish to say something and ask me some questions, and if so, I am speaking now exactly as the thoughts come into my mind. I will have an opportunity while these questions are being asked of perhaps turning over some other points that I think ought to be brought to your notice. But I do want to impress upon you gentlemen this: That sooner or later you will be compelled by legislative action, either federal or action of the state, to do something to reduce the lamentable number of accidents on your single tracks, to which I have already referred. That being so, it behooves all companies to consider what advantages you have before you whereby you can do this. I would like to tell you what happened in my own country. In 1870 there was an agitation such as occasionally arises in this country, that some action should be taken to make our railways safer. As a result a bill was brought before the British Parliament to compel railway companies to provide the block system throughout their lines. But the railway companies were able to show that they recognized the need for these safety appliances, and they satisfied the committee, with the result that the order was withdrawn. Soner or later, as I say, tht action on the part of the government, whether it is federal government or state government, will be put forward to compel American rilroads to do this. If therefore you can, by your individual expression of your views, get your companies to look into these matters such as I have referred to, and this legislation is threatened and you can prove that you recognize that something should be done and you are doing it, I believe you will save your companies considerable expense in money. The money will have to be spent sooner or later. If any legislative action is taken the money will have to be spent sooner than otherwise. I think you will serve the interests of your companies, and what is more, do something for the welfare of the traveling public all over the country.

President: We would like to hear from Mr. Groce in reply to Mr. Wilson in regard to the Illinois Central.

Mr. Groce: Mr. President, in my earlier talk I did not give any description of the machine for the reason that I was talking about the use of the telephone in connection with railroad business. I mentioned the block instrument for the reason that in connection with its operation we use the telephone for conveying information between the two operators who manipulate the block. I have read of the practices in England spoken of by Mr. Wilson, and of course to any person interested in railroad business at all the signal protection is of interest. More or less of the superintendents of telegraph present are now or have been connected with the signal departments of the railroads. I believe in some cases the superintendent of telegraph is also the signal engineer. It is not so with us on the Illinois Central, but being personally connected with the development of the little signal that we have tried, I have been working with the machine and have made most of the installations. The objection to the staff or tablet system that we thought of when we came to decide upon something to protect our trains and save us from these lamentable accidents that have been occurring, was getting this tablet at the station. I do not understand just exactly how the trains are controlled on these English roads where a man can come up there, and he must be sure when he is coming up at 60 miles an hour that he is going to get that tablet. I presume that in addition to that tablet you have a signal that shows him before he arrives at the station, whether or not he will be allowed to enter the block.

Mr. Wilson: I do not want to interrupt, but I will anticipate by saying yes, that is so.

Mr. Groce: Of course, we are starting in new on this, and the mention by Mr. Wilson of the probability of some federal or state legislation has undoubtedly stirred up the railroad men to a certain extent, but there is among all of the signal men—among all of the railroad men, a great difference of opinion as to what is best, and it was thought wise to pick up something that would be suitable for elaboration later or improvement, and while the

automatic signal is good and answers the purpose, the results on single track did not appeal to the officers of the Illinois Central Railroad. We do not claim that we have an absolutely safe block. We anticipate the extension of the protection by applying a track circuit between each block office, and the occupancy of that block in connection with slot signals will block the signals at either end of the block. Of course, even then we are so situated on some of our divisions that it will be necessary to make some permissive moves, and then would come the question of allowing a man to go in there on the danger signal—stop signal. Of course, that could be done by providing these permissive cards; but while we recognize that we have not got a thoroughly protective signal, it has, in connection with the means by which we operate the railroad, helped us a great deal, and has certainly given us a large measure of protection. We know absolutely of four cases within one year where the overlooking of orders or misunderstanding of train numbers would have invited a collision had it not been for the block; and while we will probably have to come to something more at some time, we are using this as a step, and hope to evolve something that will make the operation of a single track road perfectly safe. Of course, on double track road, as I said before, I do not think there is anything to be compared with the automatic. Nothing that we know of to-day. With the signal, as improved, the operation is safe. The feature of requiring the engineer to see a block signal moved from danger to clear is important in order to protect against an operator or block man leaving that signal at clear after it has been given to one train. In that way we overcame the necessity for the slotted signal and track circuit.

President: Are there any others who would like to make some remarks in regard to that subject?

Mr. Van Etten: I would like to ask Mr. Wilson in what way they take down that tablet; how they get it?

Mr. Wilson: That is a question soon answered. The tablets, as I think I said, are made of fibre. That is what is recommended for use now. Previously, when they were made of alu-

minum or iron, they were put in a leather pouch with a catcher on the engine and by the side of the line. I need not enlarge upon that; the thing was exchanged. But now that the fibre is found to be so light, all that is used is a wire ring about fifteen inches in diameter, and there is a hole in all the tablets through which the ring is passed. The fireman puts his arm through and throws his other arm around into a net aside of the line. That is the tablet he is giving up for the section he has just crossed. As to the engineer knowing that the tablet is there, we have, as you perhaps know, signals everywhere. We are compelled to have; and at all of these tablet stations there are home and distant signals, and we rely upon those signals, but not until he has possession of the tablet. If those do not meet your conditions it is very easy for you to put in an electrical connection.

Mr. Groce: I would like to ask Mr. Wilson as to their experience in picking up this tablet at night.

Mr. Wilson: Now, in regard to that, I took some little interest in that personally on one of my visits to Scotland one holiday: A man stands on the platform with a flaming torch (a piece of waste soaked in oil at the end of a stick, which he lights), so there is plenty of light there for the light to be effective upon the ring. We have no difficulty, I assure you.

President: We have been very much interested in Mr. Wilson's explanation of the signals on the single track in England, and I will say for the Association that we are very much obliged to him. I would like to hear now from the committee appointed a few minutes ago.

Mr. Ryder: We offer the following resolution:

Resolved, That the thanks of the Association of Railway Telegraph Superintendents be extended to the Chattanooga Electric Railway Company, the Rapid Transit Company of Chattanooga, American Telephone & Telegraph Co., East Tennessee Telephone Company, Western Union Telegraph Company, Postal Telegraph Company, the proprietor of the Read House, the vari-

ous steam railroads, the sleeping car companies and others, for courtesies extended.

W. W. Ryder,
F. S. Spafard,
E. Parsons,
Committee.

Mr. Wilson: It is a strange coincidence, but it is one that rather pleases me, that on this very day, except six hours earlier, the conference of the Telegraph Superintendents of the British Railways at their semi-annual meeting has been in session in London. I would that I could have been with you yesterday, and I should have made the suggestion that perhaps it would have been to your liking to have sent them a cable of greetings, but they will be away from there now. I don't know where they have gone, but I do not think they are working now, and if such a message could be sent by letter I would be glad to furnish particulars. I suggest to you that it would be a very nice thing to do. Whether it is your wish and desire, I throw out the suggestion.

Mr. Van Etten: Maybe we can do that by wireless telegraphy.

Mr. Kinsman: I move that the Secretary be authorized to send greetings.

Motion seconded, put and carried.

Mr. Kinsman: I move that the report of the Committee on Courtesies be adopted.

Motion seconded, put and carried.

Mr. Taltavall: If I may be permitted, I was just about to suggest that if the Secretary sends a telegram directed to Mr. J. C. Barclay in New York, he will forward it to Mr. T. W. Goulding, the General Superintendent of the Western Union in London, who will see that it reaches the proper party, probably tomorrow, the secretary of the Telegraph Superintendents who met

in London to-day. There is no doubt that it would reach the proper party within twenty-four hours.

Mr. Wilson: I think I can arrange it for you.

Mr. Lang: There is nothing new about the program for to-morrow. I will repeat that the carriages will be at the Broad street entrance of the hotel at 9:30 a. m. to go to Chickamauga Park, going by way of the National Cemetery, Orchard Knob and Missionary Ridge. Lunch is to be taken, of which we will partake when we reach the Dyer House.

Mr. Fowle: Just before closing I will say that I thought Mr. Taylor of the New York Central would be here, or Mr. Kline of the Lake Shore, and give some information in regard to their line from New York to Chicago. If anyone is interested I would be glad to have some information about that.

President: Is there anyone present who can answer Mr. Fowle on that line? Mr. Fowle, you might tell us something of the line to which you refer.

Mr. Fowle: The circuit is mainly a No. 8 B. W. G. metallic copper circuit. There are two miles of No. 19 B. & S. gauge in New York City, from the Grand Central Station to the North river. There is then one mile of No. 14 B. & S. gauge submarine cable under the North river to Weehawken, a distance of about three miles. The line is then aerial to Buffalo, via the West Shore Railroad except for a few short submarine crossings and about one mile of underground cable in the West Point tunnel. The submarine crossings and the underground cable in West Point tunnel are No. 14 B. & S. gauge cable with paper insulation, twisted pairs and lead sheaths. The circuit from New York to Buffalo is operated in one continuous length, and it is arranged so that Ravina and Syracuse may cut in. The circuit is cut through from New York to Buffalo unless Ravina or Syracuse pick it up. The circuit is operated in one section from Buffalo to Cleveland, and the last from Cleveland to Chicago. There is a branch from Ashtabula to Youngstown, and from Youngstown to Pittsburg over the Pittsburg & Lake Erie Rail-

road, and there are submarine crossings at Cleveland, Toledo and South Chicago. There is about a mile of underground at the Chicago terminus, of No. 14 B. & S. gauge cable. They are getting satisfactory service over that now. The long haul traffic is a very small proportion of the whole. Mr. Taylor said he would be very glad to have me give out any information that I would be in position to give, and he furnished me information in regard to his traffic, to show how much use of the line there is: From January 20 to March 31, a total of 71 days (I have counted out Sundays as not amounting to much, take it on the 60-day basis) shows up about seventy connections per day on the various sections between New York and Buffalo, and the largest single item of business is from New York to Albany. The use of the circuit between Buffalo and New York is not as great as the use of the circuit between Buffalo and Chicago. There are 26 calls per day out of New York, and the business between New York and Albany amounts to 16 calls per day on an average for that length of time. On the Lake Shore there are about 208 connections per day. That was taken for the month of April. The largest amount of business for any single portion of the line is, strange to say, between Ashtabula and Youngstown, not on the main line, and on that portion they are handling 44 calls per day, probably due to the ore business. They are keeping very careful track of it, and these records are made by the private branch operators. The record is made up on a sheet on special form with a regular form number. It shows the time call was made, name of the party and place at which it originated; destination; person called for; time at which connection was established; time at which it was taken down, and any delays or reason for delays in another column. The record is kept for twenty-four hours, and those reports sent to the Superintendent of Telegraph weekly, and they keep a close record of what they are doing. They also keep a record of the wire trouble and the organization for location of wire trouble is largely divisional. The division superintendent makes report each morning to the superintendent of telegraph and in that way he gets reasons for traffic delay.

President: Mr. Taylor was one of the Committee on Topics. Also Mr. Millington and Mr. Little, who are not present.

Secretary: I believe there is nothing else, Mr. President, to be brought before us now. A motion to adjourn will be in order.

Mr. Kinsman: I move we adjourn. Seconded and carried.

President: The convention is now adjourned, to meet in Denver, Colorado, the third Wednesday in June, 1906.

Exhibits and Exhibitors.

Among the exhibits were the selective telegraph instruments now being placed on the market by the Morse Code Signal Company, of Milwaukee, Wis. The exhibit was an elaborate one and showed apparatus in actual operation.

The United Electrical Manufacturing Company, of 53 Vesey street, New York, had on exhibition a number of its Autoplex dry batteries, samples of which were distributed among the members of the Association. A Martin Vibroplex transmitter was also placed where it could be examined by those present, and this very useful device was carefully looked into by all interested.

The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., and Chicago, was represented by Mr. R. B. Tyler. The exhibit of this company consisted of telephonic apparatus and other devices manufactured by the concern for railway telegraph service.

Mr. W. S. Logue, general sales agent of the Edison Manufacturing Company, New York, was present and explained the merits of the goods his company manufactured for railroad telegraph service.

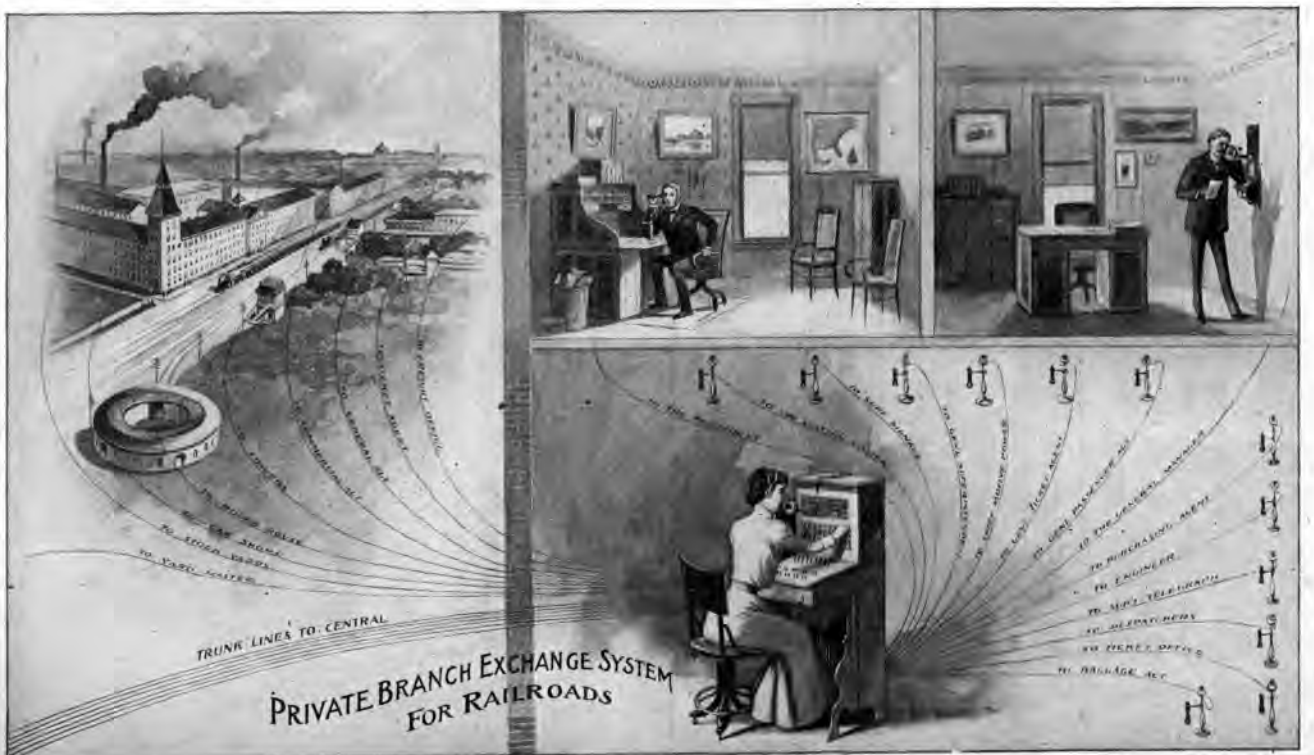
Mr. A. P. Eckert was present on behalf of the Safety Insulated Wire and Cable Company, New York.

The Railroad Supply Company, of Chicago, made no exhibit this year, but, as usual, was represented by an old member of the Association, Mr. Eugene W. Vogel, the company's signal engineer. A very neat circular of the Chicago crossing signal was

distributed. The circular shows this company's signals are in use on practically every railroad in this country and Canada, and that the signal line of the Railroad Supply Company now includes a number of signals, among which are: The American Crossing Alarm; the Ross and Holden Crossing Signal; the O'Neil Highway Alarm, and several others. Mr. Vogel stated that his company would shortly be prepared to do all kinds of electrical block signal work, and had already a number of installations in service on prominent roads.

Mr. M. J. O'Leary, of New York, secretary of the Telegraphers' Mutual Benefit Association, ably represented this well and favorably known fraternal insurance organization, and had opportunity to explain its methods to many new friends, several of whom were impressed by the result shown.

Messrs. Healey and Rugh, of the Western Telegraphone & Telegraplex Company, Chicago, gave a fine working exhibit of their appliances, which was very interesting.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